Lesser Prairie-chicken Habitat Use on the Sand Ranch and Population Status in the Caprock Wildlife Habitat Management Area, 2000

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Introduction

In 1997, the New Mexico Natural Heritage Program (NMNHP) began a study of lesser prairie-chicken (LPCH, *Tympanuchus pallidicinctus*) habitat use on the Sand Ranch, Bureau of Land Management, Roswell Field Office, New Mexico (BLM). The primary purpose of the study was to determine vegetation characteristics of habitat chosen by LPCH for nesting. We were particularly interested in any preferences for habitat that had or had not been treated with the herbicide tebuthiuron, which kills or reduces density (depending on the concentration used) of shinoak (*Quercus havardii*, see review in Peterson and Boyd 1998.).

Several pastures on the Sand Ranch were treated with tebuthiuron in the 1980s, and shinoak is greatly reduced or absent in those pastures. Hens are generally thought to nest within two miles of leks that they attend for mating (Giesen 1998 and references therein). Therefore, we captured hens at well-attended leks on traditional sites within two miles of both treated and untreated pastures, to allow hens equal choice of both habitat types.

The second objective was to gather vegetation data on the areas near and at the nest sites. We also collected a limited amount of data on nest success, hen survival within and between years, male survival, and fidelity of both sexes to lek sites. We took measurements of individual birds and blood and fecal samples for parasite screening.

The third major goal of the study was to create a database of all the Roswell Field Office LPCH data, collected since 1971. In this database we included all data on LPCH in the NMNHP's Biological and Conservation Database, data supplied by the New Mexico Department of Game and Fish (NMDGF) from their Prairie-chicken Management Areas, and data from surveys at the Carlsbad Field Office of the BLM. The resulting database, in MS Access, is the only database on LPCH in New Mexico. Copies have been supplied to the BLM Roswell Field Office, NMDGF, and the Forest Guardians, and are available from NMNHP, on BLM approval, for a nominal processing fee. This database makes it possible to track changes in the LPCH population in some areas of New Mexico over the last 30 years.

Methods

Radio Telemetry

During the peak lek attendance period, 26 March, 2000 until 5 May, 2000, we trapped LPCH at three BLM lek sites 2N, 45N, and 47N. Lek 2N was trapped on 10 days between 15 April and 3 May. Lek 45N was trapped on 37 days between 26 March and 5 May. Lek 47N was trapped for 18 days between 27 March and 14 April. Traps were removed from 47N after cattle came into the pasture and trampled the traps. The total number of lek trapping days was 65.

Birds were trapped in circular welded wire walk-in traps, placed in a line across each lek site and connected with chicken wire leads (Toepfer et al. 1987). The following data were recorded for each bird: age, sex, weight, right tarsus, left tarsus, right wing chord,

left wing chord, pinna, and culmen. Each bird trapped was uniquely banded with plastic color bands and numbered aluminum Game and Fish bands. All females were fitted with a radio transmitter, except two captured after we ran out of transmitters. We used whip antenna transmitters from AVM. All transmitters were 1997 necklace transmitters that were re-fitted with new batteries and configured with whip antennas for use in 2000.

From 10-50 microliters of blood was taken from the brachial vein and stored in cell lysing buffer for later DNA analysis. A blood smear was made for blood parasite analysis, and a fecal sample was taken for gut parasite analysis. The fecals were taken from the ground after the birds were released or from the box in which the bird was held before processing. Birds were held in boxes out of the sun before processing for up to an hour if other birds were being processed. All birds were safely released after approximately 30 minutes handling time.

Males subsequently sighted at leks were identified by their color bands, and re-sighted females were identified by either bands or transmitter frequency. We attempted to locate each female daily after banding. When a hen's nest was located, we checked the hen's location each day during incubation to ascertain that she was still incubating. If a nesting hen moved, we checked the nest. In all cases, large moves or disappearances by nesting hens coincided with nest depredation.

Parasite Analysis

Blood and fecal samples were taken in late March, April, and early June each year. To screen for coccidia, specimens were placed in vials of 2% aqueous potassium dichromate. Oocysts need to mature (sporulate) to enable identification. Specimens were placed in closed glass containers at room temperature for twelve days. After sufficient time for maturation of oocysts, suspensions were added to a solution of sugar and water (Sheather's Solution) and spun for five minutes in a centrifuge. The oocysts are buoyant in the solution and adhere to glass coverslips. The coverslips were scanned at 10x magnification for parasite eggs. Each specimen was sampled twice to confirm presence or absence of parasite oocysts.

Haemosporidian parasites can be detected by scanning smears of whole blood on a microscope slide under oil at 100x magnification. Smears were made in the field, fixed in 100% methyl alcohol to preserve the cells, and later stained with Giemsa's blood stain. Each film was scanned twice, for ten minutes, for evidence of intra- or extra-cellular blood parasites.

Vegetation

With assistance from BLM personnel, we collected vegetation data at each nest site, after all nests were empty (15 and 16 June, 2000). We employed two methods of vegetation sampling at nests, both used by Davis et al. (1979). In the line-point transects (also known as pace-point method), an X-shaped transect was centered at each nest, with arms in the four cardinal directions from the nest. Each arm consisted of 100 steps, with a point taken at the toe of the right boot every other step, such that each arm contributed 50 points and each transect approximately 200. At each point, bare ground, litter, or plant

species touched by the boot tip was recorded. If no plant was hit by the boot, the species of the nearest plant ahead of the toe was recorded. We then computed the percent of ground cover types around each nest by dividing the number of points of each ground cover type by the total number of hits or plants recorded. We also computed species composition from the nearest plant data.

A second method was used to characterize the area within 10 feet of the nest site. The same method was employed by Davis et al. (1979) to assess daily activity sites. These transects had eight arms extending 10 feet to the eight directions. Data points were taken at one-foot intervals, such that each arm provided 10 points, for 80 total points per nest. As on the large transects, litter, bare ground, and plant species were recorded. Height of the plant nearest each third data point was recorded. Percent composition of ground cover types and vegetation composition within 10 feet of the nest were then computed. We also recorded the species and height of the plant immediately surrounding or sheltering each nest.

John Spain of the Roswell Field Office provided the herbicide treatment history of all pastures in which hens nested. We created Arcview coverages showing pastures, treatment status, nest locations, and female activity patterns. Using Arcview, we computed the available area of treated and untreated habitat within a two-mile radius of each lek site where hens were captured. If hens were choosing nesting habitat randomly with respect to treatment history, then the slope of a regression of the number of nests in the untreated area around each lek on the percentage of untreated habitat around a lek should be equal to 1.0. If the slope differs greatly from 1, it is reasonable to conclude that hens did not choose nesting areas randomly with respect to treatment history.

Database

Presence/absence data collected by surveyors of the respective agencies were recorded on standard data sheets provided by BLM. We included data from observations made while we were trapping at lek sites. Data were entered into standard fields and quality checked by a second technician. Histograms were produced from data queried from the database.

If a lek was heard but not seen, the number of birds was estimated and entered into the estimate field. We entered a "1" in the count field, because, if birds were heard but not seen, we could only be certain that one male was present at the lek. Subsequent queries were based on the count field and not on the estimate field. In some cases, counts are therefore conservative estimates of the numbers of birds present at a lek site. Estimates were entered when BLM surveyors described a lek as active without providing actual counts or when NMDGF surveyors (who were NMNHP personnel in 1997-1999) heard but could not approach leks on private land. Most surveys, however, provided actual counts.

Effort varied among years at the Caprock, because of changes in personnel and resource availability. Survey methods varied among years for the NMDGF data, primarily because different organizations conducted the surveys in different years. Data should therefore be interpreted in light of effort expended and survey methods.

Results

Adult Survivorship, 1998-2000

During the study, we captured 31 different females (Table 1) and 25 different males (Table 2). Three of 12 1998 hens were recaptured and one was observed in 1999, for a minimum 1998-99 return rate of 33%. No 1999 hens were recaptured in 2000, but two 1998 hens were seen at leks, for a minimum return rate of 16.6% from 1998 to 2000. A third banded hen without a transmitter was seen in 2000. Band colors reported matched a 1998 hen that had been killed. If we assume that hen was actually banded with the next closest band combination to the one reported, three hens from 1998 and no hens from 1999 returned in 2000, for a 1998-2000 return rate of 25%. Because we could have missed seeing bands on returning birds, these numbers are minimum return rates. We observed no hens and only one male at leks other than the lek of capture, in the same or subsequent years.

None of the five 1997 males was observed in subsequent years. Five of nine 1998 males were observed in 1999, and one was seen in 2000, meaning that at least 67% of lekking males survived from 1998-99, and at least 11% survived from 1998-2000 (Table 2). Four of seven 1999 males were resighted or recaptured in 2000, suggesting that at least 57% of lekking males survived from 1999-2000. It is possible that males and females are not equally faithful to leks, although our data do not suggest that either sex typically frequents more than one lek site

Male and Female Measurements 2000

We measured 21 birds in 2000 (Table 3). Males were larger than females in weight (mean males=777.67; females=740.33; $t=-2.44$, $p=0.045$, $n=21$), wing (mean males=213.67; females=204.67; $t=-5.40$, $p<0.001$, $n=21$), and pinnae (mean males=69.5; females=29.33; $t=-18.05$, $p<0.0001$, $n=21$), but there was no difference in length between males and females in culmen (mean males=13.91; females=14.11; $t=-0.52$, $p=0.61$, $n=19$) or tarsus (mean males= 51.32; females= 51.05; $t=-0.17$, $p=0.87$, $n=21$).

Fate of 2000 Nests

We found four nests in 2000 (Table 1). It is likely that more than four hens nested and that the undetected nests were depredated before incubation began. It is difficult or impossible to find nests before hens begin incubation, because they do not stay at the nest site or sit tight on nests when humans approach. Therefore, we can only infer from hen activity patterns which nests were depredated before incubation began (Table 4).

Of the 13 hens collared in 2000, five either lost or abandoned their nests during laying. All four of the nests we found were depredated. One hen was found dead at the nest, two were probably depredated with the nest, and one survived. Of the remaining four hens, two apparently did not nest, one was depredated or left the area, and one was depredated, probably while laying. The success rate was 0/4 known nests or 0/9 probable nests.

Fate of 2000 Hens

Of the 13 hens collared in 2000, six (46%) were known still to be alive on 2 June, 2000, when we concluded the study. Three (23%) were found dead; three (23%) disappeared suddenly, two when their nests were depredated, and were therefore suspected dead; and one (8%) disappeared after being located sporadically, suggesting transmitter failure.

Vegetation 2000

Pasture. The highest percent cover (hits) in the pastures in which hens nested in 2000 (Table 5) was in litter (54.9%), followed by bare ground (30.8%). The most common plant species was *Quercus havardii* (6.2%), followed by *Aristida purpurea* and *Schizachyrium scoparium*, with approximately equal cover (1.7%).

The species composition (nearest plant) was again highest in *Q. havardii*, with 41.8%, followed by *A. purpurea* and *S. scoparium*, with 10.3% and 10.4%, respectively. All four 2000 nests were in pastures having shrub composition of over 35% (Table 6), suggesting that hens avoided pastures without shinoak. Only one nest (148) was placed in a pasture designated by BLM as having been treated, and the pasture around that nest had a higher shrub composition (40%) than that at one other nest (214, 35.5%), which was situated in an untreated pasture (Table 6). These differences would not be statistically significant with a sample size of four. This result probably occurs because nest 148 was close to the edge of the treated pasture, and treatment did not follow fence lines precisely. Alternatively, oak might have encroached from a neighboring pasture. The important point is that hen 148, like the other three 2000 hens, nested in part of a pasture composed of approximately 40% shinoak.

Nests. On the short transects near nests (Table 7), cover was highest in litter, with 69.4%, followed by bare ground, with 14.4%. The most common species was *Q. havardii*, with 4.4% cover, followed by *A. purpurea* and *S. scoparium*, with 3.4% and 3.1% cover, respectively. The species composition was 44% *Q. havardii*, followed by *A. purpurea* (15.3%) and *S. scoparium* (9.7%). Near nests, 148 had the lowest percent of shrubs (38.8%, Table 6), but the shrub composition was only slightly lower than that of 214 (41.3%), which was in an untreated pasture. Thus, hen 148 placed her nest in an area with a substantial percentage of its species in shinoak, even though the pasture was supposed to have been treated.

Plant Heights. On the short transects at nests, mean plant heights ranged from 5.4 to 10.2 inches (Table 8). These measures appeared shorter than the three closest plants to the four nests, which had mean heights ranging from 10.3 to 16.6 inches (Table 9). Thus, hens appeared to place their nests near plants that were taller than the average plants within 10 feet of the nests.

Vegetation 1998-2000

Treated versus Untreated Pastures. Thirteen of the 14 nests were placed in untreated pastures or untreated areas of otherwise treated pastures (Figure 1). The only nest in a treated area was situated in a part of a treated pasture with approximately 40% shrubs,

and the species composition within 10 feet of the nest was 38.8% shrubs. Thus, hens avoided nesting in areas with little or no oak.

Lesser prairie-chicken hens are generally believed to nest within two miles of the lek of capture (Giesen 1998). In an Arcview coverage, we created two-mile buffers around each lek where nesting hens were captured and computed the amount of area within each buffer comprising treated versus untreated habitat. We then performed a regression of the percentage of nests from each lek found in untreated habitat on the percentage of untreated area available within the two-mile buffer. If hens nested randomly with respect to treatment, the number of nests in untreated should be proportional to the amount of available untreated habitat, and the slope of the regression should not differ from 1.0. The 95% confidence interval for the slope of the regression line was -1.9209 ± 2.2087, which does not include 1.0. Thus, hens nested significantly more often in untreated habitat than expected by chance.

Species Composition Pasture. The percent composition of the three vegetation types in the pastures where the 14 nests were located (Table 6) varied from 58.3% shrubs, 39.3% grasses, and 2.4% forbs (nest 500/1998) to 35.5% shrubs, 60% grasses, and 4.4% forbs (nest 214/2000). All hens nested in pastures having at least 35% shrubs, and 12 of 14 nests were in pastures with over 40% shrubs. In all cases shinoak comprised the vast majority of shrubs (Table 5).

Species Composition Nests. The percent composition of the three vegetation types within ten feet of nests (Table 6) ranged from 69.6% shrubs, 29.1% grass, and 1.3% forbs (nest 190/1998) to 38.8% shrubs, 51.2% grass, and 10% forbs (148/2000). Vegetation around all 14 nests comprised at least 38% shrubs, and 10 of 14 nests were situated in areas having at least 50% shrubs.

The percent composition of grasses was significantly higher in pastures than near nests ($t=4.86$, $p=0.001$, $n=14$), and the percent composition of shrubs was significantly higher at nests than in pastures ($t=-2.98$, $p=0.01$, $n=14$; Table 6). This result is unexpected; if hens prefer to nest in grass clumps, then areas around nests would be expected to have more grass than the pasture as a whole, not less (see Discussion for a possible explanation).

Plant Species Sheltering Nests. All except two nests had shinoak as one of the three plants closest to the nest (Table 10). The plants closest to or sheltering the nests were *A. halli* (n=2), *Aristida purpurea* (n=7), *Q. havardii* (n=2), *Schizachyrium scoparium* (n=3), and *Y. glauca* (n=3). Only three of the 42 plants nearest nests were *A. halli,* even though Davis et al. (1979) thought it was the preferred species for nest concealment (Davis et al. 1979).

Parasite Analysis, 1998-2000. Over the three years, we screened fecal samples of 64 birds for intestinal parasites and found five positive for *Eimeria* spp. (Table 11). Of the 46 individuals screened for the presence of blood parasites, 12 slides were of poor quality and 34 were high quality enough that we are confident of our results. Infection rates in 1998 and 1999 could therefore be higher than those we report, if slide quality prevented us from detecting evidence of parasites. We found 4 individual to be positive for *Plasmodium*, or avian malaria. Four of the five (80%) were found in 1998. A bird that was positive for *Plasmodium* in 1998 was again positive when recaptured in 1999.

Database Summary.
BLM surveyors visited 138 traditional lek sites in 2000 and detected 223 birds at those leks (Figure 2). This is an increase of 132% over 1999, and an increase of 14% over 1998. Only 125 lek sites were visited in 1999, which may account for some of the increase in bird numbers in 2000; however, the mean number of birds per lek in 2000 was 9.3, up from 6.0 in 1999 and 7.8 in 1998, suggesting an actual increase in numbers. The number of active leks in 2000 was 24, up from 16 in 1999 and down from 25 in 1998.

Discussion

Database
The 2000 increases in total bird numbers, mean birds per lek, and number of active leks are consistent with signs from our field study. Relatively more second-year birds were trapped in 2000 than in previous years (93% of all hens, compared to 50% in 1999 and 42% in 1998; Table 1), and two nests were successful in 1999, both of which suggest that recruitment occurred in 1999.

Two years since 1994 (1998 and 2000) have shown over 100% increases from the previous year. The encouraging increase seen in the 1998 surveys, however, was short-lived and did not turn out to represent the first year of a positive trend. Reproductive success in 2000 appeared to be quite low, suggesting that 2001 surveys may again show lower numbers. A decrease is also expected following a year of poor rainfall, as occurred in 2000. Although the increases in 1998 and 2000 are preferable to declines, they do not constitute a stable upturn in numbers at the Sand Ranch.

Survivorship 1997-2000
None of the six birds banded in 1997 was observed in subsequent years, but this low return rate probably reflects small sample size more than it does actual survivorship. Between 1998 and 1999, 67% of males and 33% of females returned. The return rates from 1999 to 2000 were 57% for males and 0% for females. The 1998-2000 return rates were 11% for males and 16.6% for females, suggesting that the actual survival of females from 1999 to 2000 was over 16.6%, and possibly over 25%.

If male and female fidelity to lek sites is similar, and if males and females are similarly detectable, these data suggest that male survivorship was at least twice that of females from 1998-99 and 1999-2000. Detectability of both sexes may be low enough that these

numbers provide unreliable estimates of actual survival rates, but female detectability is apparently lower than that of males. For example, the 1998-1999 female return rate was 0, but at least 16.6% (and likely 25%) of the 1998 females turned up the following year, 2000. These hens may not have attended the leks in 1999, but it is also likely that they attended without being detected. Hens typically hide in the vegetation around lek sites, may spend only a few minutes at leks, and may attend in the dark early morning hours. Thus it may be more difficult to see color bands on hens than on males. In contrast, males display in the open, are present for many days at the same lek site, and stay at the lek well into daylight. Even if hens are less detectable than males, it is clear that hens suffer mortality while attending nests and males do not. Therefore, we believe that hen survivorship is actually lower than that of males, but possibly not as low as half that of males.

Fate of Nests 1998-2000

Of the 14 nests found during the study, 11 (78.6%) were entirely depredated before hatching. All three nests that reached the hatching stage were constructed in 1999. Two of the three that hatched chicks were partially depredated, and only 3/12 and 9/10 eggs hatched from those two nests. Thus, 92.9% of all nests were entirely or partially taken by predators. The only nest that hatched a complete clutch of 11 chicks certainly failed, because the hen was depredated one day after hatching. From all 14 nests, only 12 chicks were produced. It is likely that a substantial proportion of those 12 were taken in the first few weeks after hatching. These data suggest that poor recruitment is an important cause for lesser prairie-chicken decline on the Sand Ranch.

Fate of Hens1997-2000

During the study, 11 collared hens were found dead and 4 hens disappeared abruptly, suggesting that they were taken by predators and their carcasses moved from the area. The known mortality rate was at least 35.5%, and the suspected mortality was 48.4% during the three months of the breeding season in all years. Of the 10 hens found dead, eight were completely consumed except for feathers, suggesting a sizeable predator, probably a coyote. (Coyote tracks were observed near three of the consumed carcasses.) Two were found dead with no sign of predation, and appeared to have died of illness, or perhaps snake bite. Thus, it appears that predation on adults, particularly hens, is a second significant impact on the Sand Ranch population of lesser prairie-chickens.

Parasites 1998-2000

Neither *Eimeria* nor *Plasmodium* has been previously reported in LPCH. We are conducting further investigations to determine if these parasites are new species. At high concentrations, both *Eimeria* and *Plasmodium* can cause morbidity and mortality in birds (Urquhart et al. 1996, Atkinson and van Riper II, 1991). Eight of nine parasitized birds were female. Although no conclusions regarding sex biases in infection rates are possible with a small sample size, it is possible that hens suffer greater morbidity or mortality from parasite infections than do males, because they are energetically more stressed during the breeding season than males. The two hens that were found dead but not consumed may have died of parasites or illness. Parasitism and illness do not appear to

be as important as mortality factors as predation, but two out of eleven deaths (18%), if caused by parasites, would not be insignificant.

Vegetation

Lesser prairie-chicken hens preferred to nest in pastures or areas of pastures in which shrubs comprised at least 35% of the species. For all except two nests, the percentage of shrubs near nests was over 40%, and 10/14 nests were in areas with over 50% shrubs. Hens avoided nesting in pastures that had been treated with tebuthiuron, even though all three lek sites where hens were trapped offered a choice of treated and untreated pastures nearby.

The species composition in the pastures of the 2000 nests most closely resembled Davis et al.'s (1979) shinnery oak-tallgrass subtypes II and III. *S. scoparium* in pastures was closest to the subtype II percentage, while *A. halli* and *Q. havardii* were closest to the subtype III composition. Around nests, the percent total grasses and oak resembled that of subtype II, and the *A. halli* and *A. purpurea* approximated that of subtype III. We observed a similar pattern in 1998 and 1999, when species composition of shrubs, grasses, and forbs at the nest and in pastures most closely resembled that of subtype III (Johnson and Smith 1998, 1999).

Percent ground cover, however, resembled subtype I in proportions of litter and bare ground both in the pasture and at nests. Grass was closest to subtype II in both the pasture and near nests, while the shrub composition was closest to subtype III at nests.

It is not surprising that plants sheltering nests were taller than plants within 10 feet of nests, as found by Davis et al. (1979) and Johnson and Smith (1998, 1999). Mean plant height at 2000 nests was 14.16 inches, midway between the sheltering plant heights in subtypes II (16.8 inches) and III (13.3 inches), and shorter than the mean plant height in subtype I (25.1 inches). Mean plant height within 10 feet of nests was 7.98, closest to subtype III heights (8.2 inches). Unsuccessful nests in Davis et al.'s subtype III had the lowest mean plant height within ten feet of nests, 7.4 inches, which closely approximated our plant height near nests, 7.98 inches.

It is surprising that there were more shrubs near nests than in the pastures, and more grasses in pastures than near nests. A possible explanation for this result is that hens chose to nest in areas with denser vegetation, and shrubs provided that cover better than grasses did. This hypothesis is supported by the fact that the percentage of bare ground was higher in pastures (30.8%, Table 5) than near nests (14.4%, Table 7). Davis et al.(1979) found a similar pattern, which they attributed to dense vegetation near nests. In addition, mean shrub heights within 10 feet of nests was higher than mean grass heights for eight of the 14 nests. It is also interesting that 1999, the only year in which any nests were successful, was also the only year in which grass was higher than shrubs near the majority (4/6) of nests.

Alternatively, Davis et al.'s assertion that LPCH strongly prefer to nest in grass clumps may be overstated, and oak my be equally preferred as a sheltering plant (Giesen 1998), as suggested by our data (Table 10).

The vegetation in nesting pastures and within 10 feet of nests in this study most closely resembled that of Davis et al.'s (1979) subtypes II and III. Nesting success in those two subtypes was less than one-third (19% and 14%, respectively) of the nesting success in subtype I (63%). In that study 66.7% of nest failures were due to predation on the nest or the hen. The three subtypes also differ in their percentage of *A. halli*. Davis et al. concluded that the close correspondence between nesting success and proportion *A. halli* in the subtype occurs because *A. halli* provides superior nest concealment from predators.

These comparisons of our data with those of Davis et al.'s (1979) more extensive study suggest that hens are nesting on the Sand Ranch in habitat that is suboptimal for lesser prairie-chicken survival and reproduction. The density and heights of vegetation, particularly grasses, should be greater. Given the apparent preference of nesting hens for pastures having a substantial shinoak component, the best approach to achieving a lower shrub/grass ratio would not be to control oak. Rather, grazing practices should allow the proportion and height of grasses to increase without decreasing oak that is currently present. It is possible that a larger proportion of mature *A. halli* would encourage greater nesting success at the Sand Ranch.

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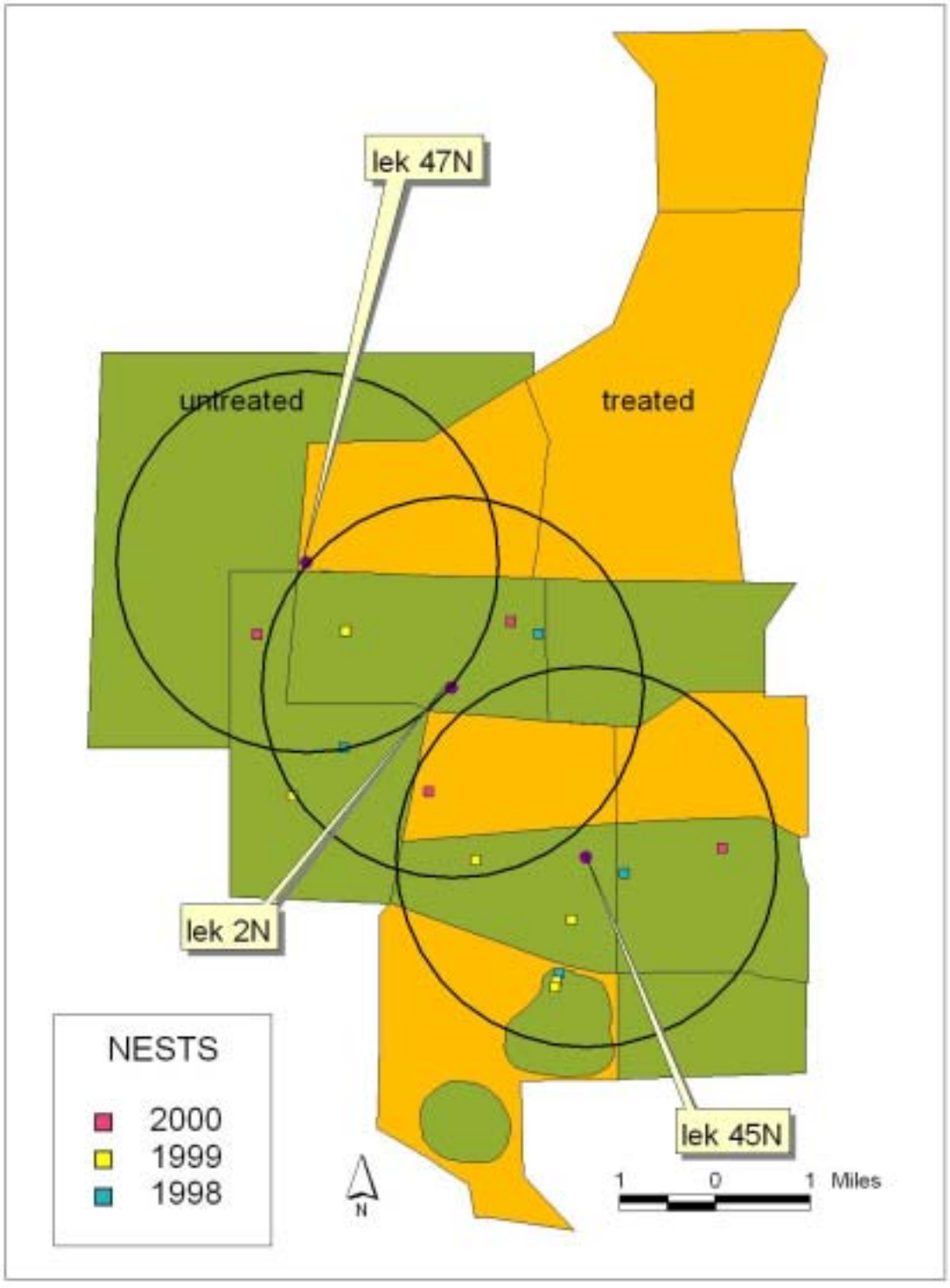

Figure 1. Map showing treated and untreated pastures within two miles of leks where hens were captured. Black circles indicated two-mile buffers around nests.

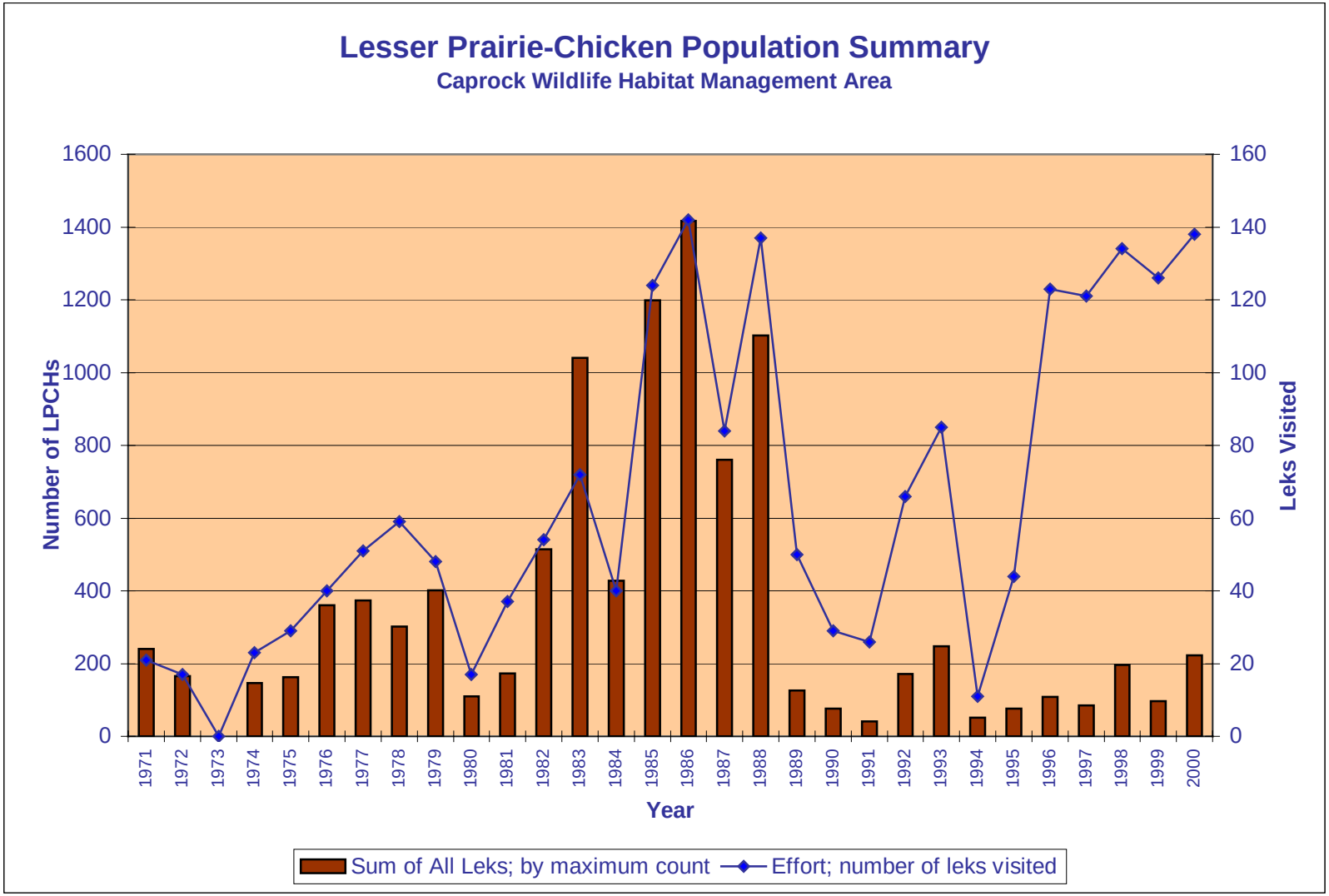

Figure 2. Lesser prairie-chicken population summary at the Caprock Wildlife Habitat Management Area, 1971-2000.

	Color Band	G/GG	B/RB	Y/WY	Y/RY	Y/PP	B/YY	W/PW	G/YY	P/GG	W/YR	P/WP	B/WB	G/RG	R/BB	P/RW	P/BB
	Aluminum Ba	**1**	**11**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**21**	**23**	**27**	**28**	**30**	**31**	**32**
1997	Frequency	165.122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Capture Date	4/16/1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lek	45N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Age	AHY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hen Depredate	5/8/1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	Frequency	-	165.480	165.400 #1	165.500	165.460	165.440	165.425	165.160	165.130	165.170	165.190	165.210	165.400 #2	-	-	-
	Capture Date	-	4/7/1998	4/9/1998	4/9/1998	4/13/1998	4/14/1998	4/14/1998	4/15/1998	4/15/1998	4/17/1998	4/19/1998	4/22/1998	5/2/1998	-	-	-
	Lek	-	45N	45N	45N	2N	2N	45N	2N	2N	45N	45N	45N	45N	-	-	-
	Age	-	SY	ASY	ASY	ASY	SY	ASY	SY	SY	SY	SY	SY	ASY	-	-	-
	Nest Found	-	-	-	5/5/1998	5/13/1998	-	-	-	5/19/1998	-	5/12/1998	-	-	-	-	-
	# eggs	-	-	-	9	?,2	-	-	-	6,1	-	10,0	-	-	-	-	-
	# chicks	-	-	-	0	0?	-	-	-	0?	-	0	-	-	-	-	-
	Hen Depredate	-	-	4/28/1998	6/3/1998	-	4/30/1998	-	-	-	-	-	-	5/20/1998	-	-	-
	Nest Depredate	-	-	-	6/3/1998	6/2/1998	-	-	-	6/2/1998	-	6/3/1989	-	-	-	-	-
1999	Frequency	-	-	-	-	-	-	165.291	-	-	165.122	165.300/.197	-	-	165.327	165.269	165.217
	Capture Date	-	-	-	-	-	-	4/14/1999	-	-	4/11/1999	4/19, 4/27/99	-	-	4/6/1999	4/6/1999	4/16/1999
	Lek	-	45N	-	-	-	-	45N	-	-	45N	45N	-	-	45N	45N	2N
	Age	-	-	-	-	-	-	ASY	-	-	ASY	ASY	-	-	SY	SY	SY
	Resightings	-	1	NA	NA	0	NA	3	0	0	3	3	0	NA	2	0	0
	Last seen at lek	-	4/9/1999	-	-	-	-	4/21/1999	-	-	4/20/1999	4/27/1999	-	-	4/15/1999	4/6/1999	4/16/1999
	Nest Found	-	-	-	-	-	-	-	-	-	5/12/1999	5/18/1999	-	-	5/4/1999	5/7/1999	5/11/1999
	# eggs	-	-	-	-	-	-	-	-	-	11,12	12	-	-	11	5,10	11
	Hatch Date	-	-	-	-	-	-	-	-	-	-	6/4/1999	-	-	5/31/1999	6/6/1999	-
	# chicks	-	-	-	-	-	-	-	-	-	-	3	-	-	11	9	0
	Hen Depredate	-	-	-	-	-	-	5/9/1999	-	-	5/22/99	-	-	-	6/1/1999		-
	Nest Depredate	-	-	-	-	-	-	-	-	-	5/22/99	-	-	-	-	-	5/17/1999
	Renest Found	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6/4/1999
	# eggs renest	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10, 9, 3
	Renest Depreda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6/11-6/18/99

	Color Band	G/GP	B/BR	B/YG	Y/RR	P/YY	R/WW	Y/GW	W/GW	R/RY	B/RW	B/WR	W/WP	Y/WR	G/WP	G/RW
	Aluminum Ba	**103**	**104**	**40**	**41**	**42**	**108**	**43**	**44**	**111**	**45**	**46**	**47**	**48**	**112**	**101**
2000	Frequency	165.257	165.291	165.148	165.228	165.32	165.35	165.167	165.339	165.213	165.297	165.329	165.31	165.236	none	none
	Capture Date	3/27/2000	3/29/2000	4/2/2000	4/3/2000	4/4/2000	4/8/2000	4/9/2000	4/9/2000	4/12/2000	4/12/2000	4/13/2000	4/15/2000	4/16/2000	4/16/2000	4/16/2000
	Lek	45N	45N	47N	47N	45N	47N	47N	47N	47N	45N	45N	45N	2N	2N	45N
	Age	SY	SY	SY	SY	SY	SY	ASY	SY	SY	SY	SY	SY	SY	SY	SY
	Nest Found			5/10/2000	5/9/2000					5/18/2000	5/14/2000					
	# eggs			7	7					?	5					
	# chicks			0	0					0	0					
	Hen Last Locat	5/21/2000	MS 4/18	5/17/2000	5/9/2000	6/1/2000	4/26/2000	6/2/2000	6/2/2000	5/23/2000	6/2/2000	6/2/2000	4/25/2000	6/2/2000		
	Hen Found Dead		4/21/2000	5/17/2000									4/25/2000			
	Nest Depredated			5/17/2000	5/12/2000					5/25/2000	6/3/2000					

Table 1. Histories of all female leser prairie chickens captured, 1997-2000.

Table 2. Histories of male lesser prairie-chickens, 1997-2000.

Band Color	Band #	Capture Date	Recap. Date	Lek	1999 Resightings	1999 Lek of Resightings	2000 Resightings	2000 Lek of Resightings
NA	2	4/17/1997		10N	0		0	
P/PP	3	4/22/1997		10N	0		0	
B/BB	4	4/24/1997		2N	0		0	
P/GP	5	4/24/1997		2N	0		0	
Y/YY	6	5/2/1997		2N	0		0	
R/RR	7	4/28/1998		24N	0		0	
W/WW	8	4/3/1998		24N	0		0	
G/YG	9	4/4/1998		24N	3	24N	0	
W/RW	10	4/5/1998		24N	4	24N	0	
B/GR	20	4/16/1998	3/26/2000	45N	15	45N	5	45N
G/WG	22	4/17/1998		2N	0		0	
B/GB	24	4/19/1998		45N	7	45N	0	
W/WR	25	4/20/1998		24N	0		0	
Y/PY	26	4/22/1998	3/30/1999	45N	14	45N	0	
G/WR	29	3/30/1999	4/20/1999	2N	13	2N	1	45N
G/BW	33	4/16/1999		2N	0		3	2N
P/BB	34	4/15/1999		2N	13	2N	0	
Y/YB	35	4/11/1999	4/13, 4/14/99	45N	5	45N	0	
Y/GR	36	4/14/1999		45N	5	45N	1	45N
B/BG	37	4/11/1999		45N	6	45N	0	
G/GY	38	4/17/1999	4/15/2000	45N	5	45N	5	45N
G/G R	39	3/28/2000	3/31/2000	47N			4	45N
B/R R	105	3/21/2000		47N			0	
W/W G	107	4/4/2000		47N			0	
G/R Y	109	4/9/2000		45N			2	45N
R/Y Y	110	4/9/2000		45N			0	

			Capture	Lek #	Cap/Rls	Sex	Age	Wt. (g)	Tarsus		Wing		Culmen	Pinna	Blood	Sample
Band #	Color	Freq.	Date		Time				L. (mm)	R. (mm)	L. (mm)	R. (mm)	(mm)	(mm)	Smear	(uL)
103	G/G P	257	3/27/2000	45N	630	F	SY	728	51.0, 51.1	52.5	213, 212	211	13.7	30	y	25
104	B/B R	291	3/29/2000	45N	612	F	SY	745	51.4, 52.1	53.1	205, 204	206	13.1	37	y	15
40	B/Y G	148	4/2/2000	47N	634/755	F	SY	725	49.5, 50.7	50.2	199, 202	205	16.6	27	y	15
41	Y/R R	228	4/3/2000	47N	710/850	F	SY	725	51.7, 51.0	51	204, 206	205	16.3	28	y	
42	P/Y Y	320	4/4/2000	45N	710/818	F	SY	729	52.9, 53.0	53	203, 208	206	13.4	30	y	50
108	R/W W	350	4/8/2000	47N	657/850	F	SY	705	49.1	47	208	202	14.96	22	y	
44	W/G W	339	4/9/2000	47N	619/824	F	SY	760	50.8, 52.2	51	209, 209	200	12.9	30	y	
43	Y/G W	167	4/9/2000	47N	619/824	F	ASY	770	51.1, 51.3	50.8	206, 209	206	14.9	28	y	
111	R/R Y	213	4/12/2000	47N	816/902	F	SY	770	49.7, 50.4	49.2	204, 202	199	13.3	25	y	40
45	B/R W	297	4/12/2000	45N	705	F	SY	700	51.0, 52.5	50.8	206, 204	200	12.7	21	y	50
46	B/W R	329	4/13/2000	45N	710/815	F	SY	730	52.4, 51.5	51.4	205/204	204	14.9	32	y	25
47	W/W P	310	4/15/2000	45N	710/740	F	SY	773	52.6, 52.8	53	205, 206	204	14.3	32	y	50
48	Y/W R	236	4/16/2000	45N	618/730	F	SY	760	49.9, 50.5	50	209,210	209	13	38	y	25
112	G/W P	none	4/16/2000	2N	618/1045	F	SY	715	50.9, 51.4	51.6	203, 203	204	13.4	30	y	25
101	G/R W	none	4/16/2000	45N	645/1045	F	SY	770	50.0, 48.8	51.1	210, 210	209	14.2	30	y	25
110	R/Y Y	none	4/9/2000	45N	730/820	M	SY	720	48.6, 49.2	47.9	211, 212	214	12.9	70	y	
109	G/R Y	none	4/9/2000	45N	610/730	M	SY	765	47.1, 47.4	45.2	211, 212	210	14.1	75	n	
107	W/W G	none	4/4/2000	47N	740	M	SY	775	53.2, 52.9	53.2	215, 215	217	14.5	70	y	10
105	B/R R	none	3/31/2000	47N	536/710	M	ASY	805	51.8, 52.0	54.6	216, 218	215	13.9	71	y	25
39	G/G R	none	3/28/2000	47N	600/737	M	ASY	816	53, 53.3	54	211, 210	209	14	61	y	25
20	B/G R	none	3/26/2000	45N	630	M	ASY	785	53.5, 53.6	53	216, 216	217	14.1	70	y	5

Table 3. Measurements of all lesser prairie chickens captured in 2000.

Table 4. Fate of radio collared hens in 2000.

257	Nest probably depredated on day 10 before found
291	Hen locations never clustered; moved NW, then back to lek, was killed. No nest?
148	Hen found dead at nest.
228	One hen bearing on 5/10-14; then hen disappeared. Hen probably depredated with nest.
320	Hen locations never clustered; hen made long moves N-S. No nest?
350	Disappeared 18 d. after capture; no clustering of hen locations. No nest? Hen depredated or left area?
167	Probably lost nest before incubation
339	Walked in 3 times to 2nd clustering area. Not nesting. Early failure or no nest.
213	Hen disappeared one day before we discovered nest depredated. Hen probably taken also.
297	Hen incubating until nest depredated; hen stayed around.
329	Hen settled briefly, then moved back to 45N area, stayed a few days, then big move west. Probably lost nest after 1st move.
310	Hen depredated, probably while laying.
236	Hen locations clustered for a few days, then moved. Probably lost nest while laying.

Table 5. Vegetation of pastures in which lesser prairie-chicken nests were located, 2000.

2000 Vegetation - Pasture		**Nearest Plant**	**Hits**
Species	Acronym	Percent	
Perennial forb	PPFF	0.0235	
Anunual forb	ANFO	0.0039	
Andropogon halli	ANHA	0.0517	0.0050
Aristida purpurea	ARPU	0.1031	0.0171
Bouteloua hirsuta	BOHI	0.0902	0.0133
Bouteloua curtipendula	BOCU	0.0130	0.0012
Carex sp.	CAREX	0.0019	
Cenchrus carolinianus	CEPA	0.0025	
Digitaria cognata	DICO	0.0820	0.0121
Eragrostis secundiflora	ERSE	0.0068	0.0014
Paspalum setaceum	PASE	0.0177	0.0012
Schizachyrium scoparium	SCSC	0.1039	0.0177
Sporobolus cryptandrous	SPCR	0.0332	0.0066
Sporobolus flexuosus	SPFL		
Sporobolus contractus	SPCO	0.0089	
Sporobolus giganteus	SPGI	0.0127	
Artemesia filifolia	ARFI	0.0057	0.0014
Opuntia phaeacantha	OPPH	0.0007	0.0007
Prosopis glandulosa	PRGL		
Quercus havardii	QUHA	0.4181	0.0622
Yucca glauca	YUGL	0.0212	0.0026
Bare Ground	BG		0.3081
Litter	L		0.5494
shrubs		0.4458	0.0669
grasses		0.5208	0.0742
forbs		0.0341	0.0014
bare ground			0.3081
litter			0.5494

Table 6. Summary of vegetation types in pastures and within 10 feet of all nests, 1998-2000.

Nest/Year		Pasture			Nest	
	% Shrubs	% Grass	% Forbs	% Shrub	% Grass	% Forbs
148/2000	0.405	0.58	0.015	0.388	0.512	0.1
228/2000	0.507	0.456	0.023	0.625	0.338	0.038
297/2000	0.516	0.457	0.027	0.625	0.363	0.013
214/2000	0.355	0.6	0.044	0.413	0.588	0
217/1999	0.352	0.588	0.065	0.363	0.45	0.188
327/1999	0.568	0.437	0	0.55	0.375	0.075
197/1999	0.523	0.472	0.01	0.638	0.325	0
122/1999	0.553	0.432	0.015	0.438	0.475	0.088
217-2/1999	0.442	0.452	0.111	0.613	0.325	0.05
269/1999	0.422	0.528	0.05	0.55	0.375	0.075
190/1998	0.46	0.49	0.05	0.696	0.291	0.013
130/1998	0.45	0.545	0.005	0.563	0.438	0
460/1998	0.562	0.403	0.035	0.607	0.392	0
500/1998	0.583	0.393	0.024	0.625	0.363	0.013

Table 7. Vegetation within 10 feet of lesser prairie-chicken nests, 2000.

2000 Vegetation - Nests		**Nearest Plant**	**Hits**
Species	Acronym	Percent	
Perennial forb	PPFF	0.025	
Anunual forb	ANFO	0.0125	
Andropogon halli	ANHA	0.03125	0.00938
Aristida purpurea	ARPU	0.153125	0.03438
Bouteloua hirsuta	BOHI	0.046875	0.00313
Cenchrus carolinianus	CEPA	0.0125	
Digitaria cognata	DICO	0.04375	0.00313
Eragrostis secundiflora	ERSE		
Paspalum setaceum	PASE	0.01875	
Schizachyrium scoparium	SCSC	0.096875	0.03125
Sporobolus cryptandrous	SPCR	0.046875	0.00938
Sporobolus flexuosus	SPFL		
Sporobolus contractus	SPCO		
Sporobolus giganteus	SPGI		
Artemesia filifolia	ARFI	0.01875	
Gutierrezia sarothrae	GUSA	0.0125	0.00625
Opuntia phaeacantha	OPPH		
Prosopis glandulosa	PRGL		
Quercus havardii	QUHA	0.440625	0.04375
Yucca glauca	YUGL	0.040625	0.02188
Bare Ground	BG		0.14375
Litter	L		0.69375
shrubs		0.5125	0.07188
grasses		0.45	0.09063
forbs		0.0375	0
bare ground			0.14375
litter			0.69375

Table 8. Summary statistics of plant heights within 10 feet of nests, 2000.

	Nest 148	*Nest 228*	*Nest 297*	*Nest 214*
Mean	5.46	8.83	10.21	7.46
SE	0.68	1.31	1.83	0.97
Median	4.00	7.00	7.00	6.00
Mode	4.00	7.00	7.00	6.00
SD	3.31	6.43	8.99	4.74
Variance	10.98	41.36	80.78	22.43
Kurtosis	-1.40	14.66	5.68	0.15
Skewness	0.39	3.52	2.39	0.92
Range	10.50	33.00	36.00	16.00
Minimum	0.50	3.00	2.00	2.00
Maximum	11.00	36.00	38.00	18.00
Sum	131.00	212.00	245.00	179.00
Count	24.00	24.00	24.00	24.00

Table 9. Summary statistics of plant heights sheltering nests, 2000.

	Nest 148	*Nest 228*	*Nest 297*	*Nest 214*
Mean	16.67	10.33	16.33	13.33
SE	4.67	0.88	1.20	2.91
Median	12.00	10.00	17.00	14.00
Mode	12.00			
SD	8.08	1.53	2.08	5.03
Variance	65.33	2.33	4.33	25.33
Skewness	1.73	0.94	-1.29	-0.59
Range	14.00	3.00	4.00	10.00
Minimum	12.00	9.00	14.00	8.00
Maximum	26.00	12.00	18.00	18.00
Sum	50.00	31.00	49.00	40.00
Count	3.00	3.00	3.00	3.00

Table 10. Identity of three plants nearest nests, 1998-2000. Asterisks indicate plants providing direct concealment to nests.

Nest/Year	Plants Nearest Nest
148/2000	ARPU, QUHA, YULE*
228/2000	ARPU*, QUHA, SPCR
297/2000	ANHA*, ANHA, QUHA
214/2000	ARPU*, QUHA*, YULE*
217/1999	BOHI, QUHA, SCSC*
327/1999	ARPU, QUHA, SCSC*
197/1999	ARPU, QUHA, YULE*
122/1999	ARPU*, ARPU, QUHA
217-2/1999	ANHA, ARPU*, BOHI
269/1999	ARPU*, BOHI, BOHI
190/1998	ARPU, QUHA, SCSC*
130/1998	ANHA*, BOHI, QUHA
460/1998	ARPU*, ARPU, QUHA
500/1998	ARPU*, QUHA*, YULE

Table 11. Summary of parasite analysis, 1998-2000.

	***Eimeria* spp.**		***Plasmodium* spp.**	
Year	**+,-**	**Infection Rate (%)**	**+,-**	**Infection Rate (%)**
1998	1,20	.048	4, 16	.20
1999	0,23	0	1,11	.08
2000	4,16	.20	0,14	0