Final Report

New Mexico Lesser Prairie-Chicken Project 2000

George Miksch Sutton Avian Research Center
P. O. Box 2007
Bartlesville, Oklahoma 74005
USA
918-336-7778
918-336-7783 fax

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EXECUTIVE SUMMARY

1. In Spring 2000 the Sutton Avian Research Center studied Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) in Roosevelt County, eastern New Mexico. Our objectives were to compare areas managed for prairie-chickens (PCAs) with nearby private ranches in such characteristics as mortality rates, nest success, and habitat use.
2. We trapped 34 new cocks and 20 new hens in spring 2000. In addition, we recaptured three cocks originally captured in 1999.
3. Annual survivorship (2nd Quarter 1999 – 2nd Quarter 2000) of all birds was about 50%, but the annual survivorship for hens was very low, probably near 10%, while that of cocks was much higher, probably around 65%.
4. The maximum distance moved by the prairie-chickens was on average about 2.90 km, and the average home range size was about 6 sq. km, although one bird had a home range of over 50 sq. km. Both of these are generally larger than the smaller PCAs.
5. We located seven nests in 2000. Four of these were successful, with a Mayfield nest success probability of 41%. All nest failures were a result of predation.
6. Prairie-chicken hens generally selected areas for nesting with a greater amount of shinnery oak stems and with a lower grass density in the near-ground level than found in the general habitat, and avoided areas with other woody plant species.
7. Although the sample size was too small for statistical analysis, successful nests generally had greater canopy cover and less basal cover than unsuccessful nests.
8. Nests were an average of 0.96 km from the lek on which the hen was trapped.
9. Of 184 blood samples collected in 1999 and 2000, all were negative for the presence of reticuloendotheliosis viruses.
10. Fifty-eight samples were analyzed for genetic heterozygosity. Although it appears from this very preliminary analysis that inbreeding may not be a problem, further analysis will be necessary.
11. Comparison of the general habitat available on the PCAs with that of the adjacent ranches shows that the ranches generally had less canopy cover by shinnery oak, more basal cover by shortgrasses, and a lower vegetation height. The composition and structure of vegetation on the PCAs is probably more similar to the nesting habitat selected by the prairie-chickens than the vegetation on the private ranches.
12. Comparison of the Weaver Ranch and PCAs shows that the ranch has less shinnery oak canopy cover than do the PCAs and the maximum vegetation height on the Weaver Ranch is lower. At the near-ground level, the Weaver Ranch has much more vegetation than do the PCAs.
13. Conclusions can be seen on Page 41.

INTRODUCTION

The Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*), like many other species of prairie grouse, has experienced considerable declines in both occupied range and population density in recent years. In 1995, the U.S. Fish and Wildlife Service (USFWS) received a petition to list Lesser Prairie-Chickens as Threatened under the Endangered Species Act. Nearly three years after that date, the USFWS declared the species to be "warranted but precluded" from listing, in June 1998. This finding means that the species becomes a candidate for future listing and that its status must be re-evaluated annually.

Lesser Prairie-Chickens occur in shinnery oak (*Quercus havardii*) grasslands and sand sagebrush (*Artemisia filifolia*) grasslands of western Texas, northwestern Oklahoma, eastern New Mexico, southwestern Kansas, and southeastern Colorado. Individual populations within this occupied range have become physically separated, and may be genetically isolated. Also, the habitat characteristics vary somewhat from site to site. The Lesser Prairie-Chicken population occurring in southeastern New Mexico is probably the most geographically isolated population. Although it ranges into adjacent Cochran and Bailey counties in Texas, about 400 kilometers separate it from the larger, more contiguous population that occurs in the northeastern corner of the Texas Panhandle and northwestern Oklahoma.

George M. Sutton Avian Research Center (GMSARC) became involved with Greater Prairie-Chicken (*Tympanuchus cupido pinnatus*) research in Osage County, northeastern Oklahoma in 1997, after it was realized that Greater Prairie-Chickens were also experiencing significant declines in many parts of their range. It was clear that the trapping and radio tracking techniques used and perfected by GMSARC in this study could be easily modified and applied to Lesser Prairie-Chicken Research. In 1999, funding became available from the Western Governor's Association, USFWS, and private sources to begin research on Lesser Prairie-Chickens in Beaver, Ellis, and Harper counties, northwestern Oklahoma, and Roosevelt County, southeastern New Mexico. Mr. Jim Weaver, former Peregrine Fund biologist, Lesser Prairie-Chicken Interstate Working Group participant, and rancher in New Mexico volunteered his property for research in New Mexico by GMSARC. This research was fully endorsed and encouraged by the Lesser Prairie-Chicken Interstate Working Group, the Western Governor's Association, and the USFWS. After the first year of trapping and radio tracking, the New Mexico Department of Game and Fish (NMG&F) contracted with GMSARC to further the research efforts, especially to assess the current management of New Mexico Game Commission prairie-chicken management areas in Roosevelt County.

We began trapping and radioing Lesser Prairie-Chickens in Roosevelt County, New Mexico in April 1999, and have now captured and radioed 88 birds there. Our research in western Oklahoma began in March 1999 and a total of 116 birds have now been captured and radioed at that site. Methodology at both sites is identical, except for minor differences in vegetation sampling (our Oklahoma study site is primarily sand sagebrush prairie, while the New Mexico site is primarily shinnery oak prairie). We believe that conducting research at these two sites simultaneously will allow us to better determine factors contributing to Lesser Prairie-Chicken declines.

PROBLEM

Prior to the beginning of the 20th century, it was estimated that as many as two million Lesser Prairie-Chickens occurred in the Texas Panhandle (Litton 1978). Taylor and Guthery (1980) claimed that range-wide distribution decreased by 78% between 1963 and 1980. Both the occupied range and population size has continued to decline since that time (e.g. Oklahoma Department of Wildlife Conservation data indicate an 87% decline in Oklahoma from 1982 through 1999). Most research efforts have focused on a narrow portion of prairie-chicken biology, a small geographic region, and / or for a short duration. GMSARC's five-year study plan in two different states simultaneously is the first time a large-scale, long-term, multi-state research effort has been attempted on Lesser Prairie-Chickens.

Past efforts in saving declining forms of other prairie-chickens have met with little success. The best conservation strategies known during the latter half of the 19th century and early part of the 20th century were practiced with the Heath Hen (*Tympanuchus cupido cupido*), but in spite of these efforts, this eastern prairie-chicken became extinct in 1932. The same scenario is being played out in southern Texas today with the Attwater's Prairie-Chicken (*Tympanuchus cupido attwateri*), where fewer than 50 birds remain in the wild.

Factors responsible for declines in Lesser Prairie-Chickens may vary between locations, but it is expected that at least some of those factors may be consistent across sites as well. Some of the factors seem obvious, such as extended periods of drought and wide-scale conversion of prairies into cultivated fields. However, smaller agricultural areas interspersed within native grasslands may provide food sources that could benefit the species. Subtle changes in plant composition in native prairies may be altering the availability of nesting or roosting habitat or food supplies. With the ever-widening gap between sub-populations, the possibility of genetic depression certainly needs to be considered. Little is yet known about diseases and the effects associated with those diseases in prairie-chickens. An example of this is the discovery of reticuloendotheliosis in Attwater's Prairie-Chickens less than 10 years ago. This retrovirus was identified as the cause for several deaths of captive Greater and Attwater's Prairie-Chickens in breeding facilities in Texas, has been discovered and thought to be a mortality factor in wild populations of Attwater's Prairie-Chickens, and has been found in Greater Prairie-Chickens in Oklahoma (GMSARC, unpublished data). No known cases of reticuloendotheliosis have been found in Lesser Prairie-Chickens, but the presence in other forms of prairie-chickens and the potentially lethal affects warrant further investigation. Changes in the numbers or composition of predatory species may be causing higher mortality rates or lower nesting success. Also, the ever-growing number of overhead power lines and associated power poles can result in higher mortality rates. Collisions with overhead power lines are a common and lethal occurrence, and the poles may increase the perch availability for raptors. Most importantly, the cumulative effects of these and other unknown factors have yet to be quantified.

The technology available to researchers today, such as Geographic Information Systems (GIS), improvements in radio telemetry equipment, Global Positioning System (GPS) location technology, advanced genetic and serological techniques, etc., allows researchers the opportunity to build on and improve upon previous research efforts in order to better identify factors contributing to declines in prairie-chickens and to better develop management plans to help reverse those declines. Landowner incentive programs and other partnerships between federal and state agencies and private landowners can greatly enhance the chance of recovery, provided they are provided with the tools to do so. The "tools" include the findings of research such as this. Cooperation and communication between GMSARC, Texas A&M University (conducting Lesser Prairie-Chicken research in Texas), Kansas State University (conducting Lesser Prairie-Chicken research in Kansas), state agencies, federal agencies, and private landowners is essential in finding solutions to the plight that Lesser Prairie-Chickens are facing.

OBJECTIVES

For this study our objectives are to:

Compare New Mexico Game Commission-managed lands for Lesser Prairie-Chickens (Prairie-Chicken Areas, or PCAs) with non-PCA private lands in eastern New Mexico, with regards to prairie-chicken population density, nest success, and adult mortality.

Null hypotheses:

- H_0: Prairie-chicken nest success is equal on PCAs and on nearby private lands.
- H_0: Prairie-chicken adult mortality is equal on PCAs and on nearby private lands.

Describe habitat used by the prairie-chickens with regard to plant species composition, grass density and height, ground cover, and shinnery oak cover and density. We will characterize the breeding-season habitat use of the prairie-chickens, and examine differences in habitat use between sexes.

Null hypothesis:

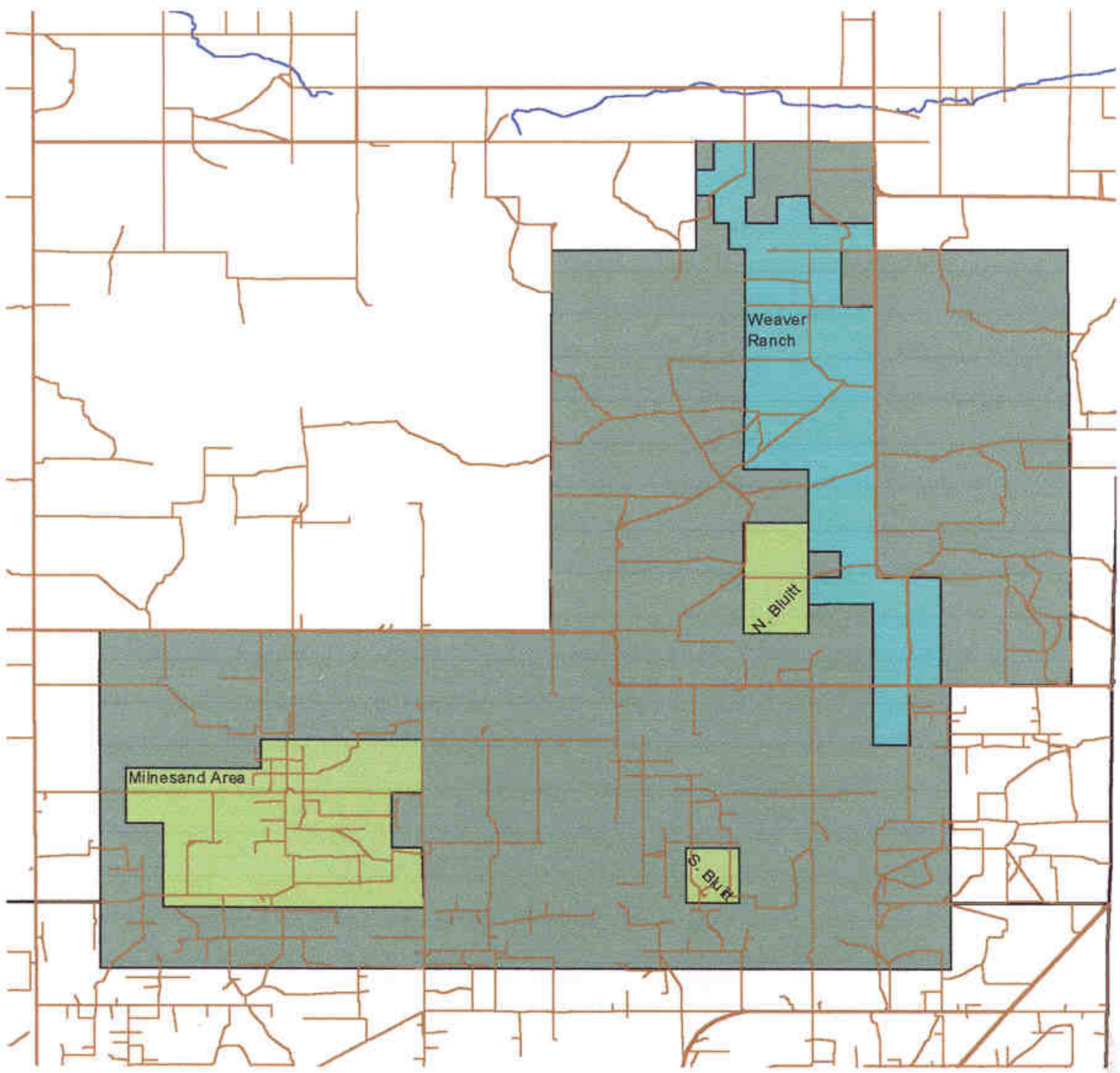
- H_0: Habitat is equal on PCAs and on nearby private lands.

METHODS

Study Area

Our study area includes about 52,000 ha (200 sq. mi) in southeastern Roosevelt County, New Mexico. The area is located on the western edge of the Llano Estacado, and is characterized by sandy soils on top of caliche bedrock, sand dunes and associated blowouts, and scattered playas (which make up the only surface water). The dominant vegetation is shinnery oak, which mostly occurs in the clonal shrub form, although a few hybrid mottes can be found reaching a height of about 3-4 meters. Other common woody vegetation includes sand sagebrush, honey mesquite (*Prosopis glandulosa*), cholla (*Opuntia imbricata*), broom snakeweed (*Gutierrezia sarothrae*), and yucca (*Yucca* spp.). Common grasses include sand bluestem (*Andropogon hallii*), silver bluestem (*Bothriochloa laguroides*), little bluestem (*Schizachyrium scoparium*), dropseeds (*Sporobolus* spp.), grama grasses (*Bouteloua* spp.), and buffalo grass (*Buchloe dactyloides*). Peterson and Boyd (1998) give a comprehensive list of other plants associated with shinnery oak communities.

Fig. 1. Study area, south of Causey, New Mexico. The outer, dark green area defines the entire study area. Lighter green areas are the approximate boundaries of the PCAs and the aquamarine area is the approximate boundaries of the Weaver Ranch. The remainder of the area is comprised of other private ranches.



Although most of the land area is native shinnery oak / mixed grass prairie or reclaimed agricultural lands, some (<10%) is currently under cultivation, primarily in cotton production. Past and present oil production accounts for about 5% of the land area being caliche oil pads, and caliche, limestone, or dirt roads. A few brine scars can also be found near active or old oil wells, but the rarity and small size of these scars amount to an insignificant portion of the land area.

Most of the land is privately owned. However, the New Mexico Game Commission owns several prairie-chicken management areas, which comprise about 3700 ha of our study area. These include the Milnesand Prairie-Chicken Area, the North Bluitt Prairie-Chicken Area, and the South Bluitt Prairie-Chicken Area. ("Prairie-Chicken Area" will hereinafter be abbreviated PCA.) Cattle have been excluded from these areas for several years, which allows for some comparison to privately owned, cattle-grazed lands adjacent or nearby these areas.

Trapping

We trapped birds on gobbling grounds in spring 1999, fall 1999, and spring 2000. Trapping was accomplished by using a series of walk-in funnel traps connected by 8 m (25-foot) lengths of plastic drift fence in a large "W" array. Anywhere from seven to 20 traps were used on each gobbling ground, depending on the gobbling ground size and trap availability. Traps were constructed from 2x4 inch, 12.5-gauge welded wire, are 48 inches in diameter, 28 inches tall, have four funnel openings, and nylon netting stretched tight across the trap at a height of 16 inches. The traps also have a welded wire top, and the 12 inches between the top and the net keeps the birds from injuring themselves on the top of the trap, as well as offers protection from above in the unlikely case of a raptor attempting to catch a bird inside a trap. All cut wire ends were filed smooth to prevent birds cutting themselves, and traps were inspected daily for broken welds, loose wires, etc. Traps were never left unattended when they were set for catching birds. When trapping ceased each day, access doors on the traps were wired open to allow for an exit if a bird entered a trap when we were not present.

Once one bird was inside a trap, a second or third bird was likely to get caught in the same trap. Thus, we would leave birds in traps for upwards of an hour or so. We would continue to observe the bird, and were ready to intervene immediately if the bird seemed stressed, hurt, or was fighting with a second bird. Birds were removed by opening one or two of the access doors, reaching in and grabbing the bird by hand. They would immediately get an infant sock placed over their head to keep them calm, and were placed in large cotton bird bags. If three or more birds were caught in a trapping session, they were placed in wooden holding boxes to keep them calm and cool until they could be processed.

Processing consisted of weighing the bird while still in the bag to the nearest 10 g (the empty bag was weighed after the bird was removed, and that weight subtracted from the first to get the bird's weight). We then measured the wind-chord length and tail length. We also measured the diameters of the shafts of primaries 8 and 9, which were used to calculate the bird's age (other aging methods were used as well, including the shape of the primaries and relative wear on the primary tips). All birds were fitted with a 7/16 inch diameter, serially numbered aluminum band to allow for positive identification when recaptured or recovered. About 1 cc of blood was taken from the ulnar vein with a syringe to be used for genetic analyses and for survey for retroviruses, and the bird was examined for the presence of ectoparasites (lice and ticks).

Birds were then fitted with a 15-gram, loop antenna, bib-mount radio transmitter. These transmitters weighed <2% of the bird's weight. The transmitters were custom made to our specifications by Telemetry Solutions, Inc. and Wildlife Materials, Inc. The loop antenna is believed to be safer for the bird than the more commonly used whip antennas, which are suspected to cause higher mortality due to flight feather abrasion. The bib-mount is also thought to be safer than the more common ligature devices used on most necklace-mounted transmitters, as there is no possibility of attaching it too tightly. The bib material is made of brown-colored 19 oz. vinyl-coated nylon, and the transmitter itself is attached to the bib with cyanoacrylic cement and monofilament. The transmitters were attached to the birds by cutting a small hole (about 1 cm diameter) in the bib in the middle of the antenna loop, and cutting eight slits radiating from the center. The transmitters would then be test-fitted to the birds, and we gradually enlarged the opening to go snugly over the bird's head. If the transmitter slipped over too easily (i.e. the hole was too large), a different transmitter was used. Once over the bird's head, the transmitter was worked down the neck toward the breast, and breast feathers were pulled through the opening. This assured that the transmitter was totally or mostly hidden, as well as unlikely to come off since the feathers helped hold it in place. Transmitter frequencies ranged from 148.000 MHz to 149.990 MHz, and each was separated from other transmitters by at least 10 kHz, thus a maximum of 199 unique frequencies could be deployed.

Once all data were collected on a bird, transmitters mounted, and blood taken, the bird was held upright for several minutes to allow it to equilibrate and regain its balance. If the bird showed any sign of scrapes or cuts from the traps, alum (clotting agent) and / or Neosporin® (antibiotic ointment) was applied to the wound. Cyanoacrylic cement (super glue) was kept on-hand in case a larger cut needed to be closed, but it was never necessary. The birds were then set gently on the ground at a location free of obstructions (fences, trees, cholla, etc.), so that they could escape by flying or walking.

Until late spring of 2000, all the radio transmitters deployed had an estimated battery life of about 12 months. We have, however, tracked several birds for at least 15 months that had not had transmitters replaced. Based on our experience on the battery life on the transmitters, we project that the normal range of normal battery life really falls between 12 and 16 months. We attempted to replace transmitters on as many of the birds as possible in July and August 1999. At that time of year, the birds are molting flight feathers and typically, over the course of 8-10 weeks, molt primaries at the rate of one or two per week. Since it takes about two weeks for the new primaries to reach full size, most birds will be missing two or three primaries at any given time. Although the birds are never flightless, this molt period alters their behavior somewhat, causing them to attempt to elude predators by either sitting extremely still or by running on the ground. (They likely expend much more energy when flying in this condition). We tried to use this time period to our advantage, with the idea that a fresh battery deployed then would last at least until that time the following year. This involves two field personnel equipped with receivers and Yagi antennas tracking the target bird at night, and trying to get good directional signals from 90 degrees apart, relative to the bird's position. Once the radio trackers had the bird pin-pointed, two to four other field personnel would converge on the spot with long-handled, 24-inch diameter landing nets, and look for the bird on the ground. Once spotted, the closest person would stealthily approach the bird to within the length of the net and attempt to catch the bird on the ground. Prior to initiating this procedure in 1997 in Oklahoma (with Greater Prairie-Chickens, a considerable number of nights were spent tracking birds, to determine how many times they are disturbed from predators while roosting. Most birds were being "bumped" one or more times each night, so we feel like our efforts (especially since it was usually only one night on each bird) contributed only a minor amount of additional disturbance in an already restless night. This method has worked well at our Lesser Prairie-Chicken and Greater Prairie-Chicken study sites in Oklahoma. In this part of New Mexico, however, the constant rustling of navigating through shinnery oak made it difficult to approach the birds quietly without scaring them. Thus, only three birds were recaptured by this method in 1999.

Radio transmitters deployed in spring 2000 had an estimated battery life ranging from 12 months to 20 months, depending on manufacturer and model. All new transmitters placed into use in the future will have about 20 months battery life (refurbished transmitters with 12-month batteries will still be used as well). This improved battery life has come about as a result of continued communication between GMSARC and the transmitter manufacturers, whereby we found a way to lessen the transmitter weight by about two grams. This allows using a larger battery while maintaining the goal of transmitters weighing <2% of the bird's body weight. This change will almost totally eliminate the need to recapture birds for battery replacement, as very few individuals should outlive the battery life of the transmitters. Campbell (1972) estimated an annual survivorship of 35%; assuming this is true, on the average, less than 20% of the birds are expected to live longer than 20 months.

Radio Tracking

Radio tracking of birds began the same day they were first captured and radioed. Birds were then tracked as often as time allowed, and at varying times of day and night. Radio tracking equipment consists of five-element, handheld Yagi antennas and ATS Inc. model R-2000 or R-4000 receivers. These receivers have built-in memory banks and scanners to aid in detecting birds. Once a bird was detected, our personnel would walk toward the bird until signal strength noticeably increased, at which time they would start walking around the bird, keep it on one side of them until they had proceeded at least 90 degrees around it and within 50 meters of it. Great care was practiced in tracking to avoid accidentally flushing the birds. Occasionally, however, birds were intentionally flushed; for example, when a bird was found to be at the same location for two or more consecutive days (mortality switches might not be working or scavengers might be moving the transmitter around), or if there was some concern over the bird's health, intentional flushes were initiated. Once an individual's location was confirmed, a handheld GPS unit was used to determine the latitude and longitude (to the nearest 0.01 minute). The latitude, longitude, date, time, and any pertinent notes were recorded in a pocket notebook, and transcribed onto standardized data forms later in the day.

Each technician was assigned a group of birds to track, up to about 25 birds, depending on both the number of birds we were tracking and the number of field personnel. Each person was scheduled to begin the first day of his or her five-day work week at 1400, and work until 2300. Each subsequent day, they began and ended two hours earlier; until by the last day of their workweek, they were working 0600-1500. This schedule facilitated tracking birds at various times of the day and night, and maximized the number of hours / day that someone was in the field (e.g. with four field personnel, there would be four days each week that someone was starting at 0600, three days that someone was starting at 0800, and four days that someone was out until 2300). During trapping seasons, this schedule was modified so that we could maximize the available personnel for early morning trapping.

If a bird was found dead (our transmitters have a mortality feature incorporated into them that causes the pulse rate to double if the transmitter does not move for 12 hours), the carcass was photographed, all remains were collected, and the area was searched for tracks, feces, etc. Other information collected at the mortality site included the distance to the nearest fence, the distance to the nearest power lines, the type of habitat, the distance to the nearest cultivated field, etc. The carcasses were examined for clues (stripped tendons, bite marks on bones or transmitters, plucked feathers, chewed feathers, etc.) that could aid in determining mortality causes (Dumke and Pils 1973).

Often, more than one bird would be detected when scanning. Personnel would usually track the bird that had gone the longest since last being tracked. Also, during nesting season, hens were tracked more frequently than cocks, sometimes even to the exclusion of tracking cocks. When trapping on gobbling grounds, a scan was made every 30 minutes to determine which birds were present; sometimes birds were detected at these intervals, but appeared merely to be in the area and not on the gobbling ground. In all of these cases, birds that were detected but not tracked were still recorded as detected, as their presence can be used to calculate daily survivorship rates.

Due to the paucity of roads, limited range of the transmitters (about 1.6 km or 1 mile), and greater margin of error, triangulation on signals to determine a bird's location was rarely necessary. While triangulation is recognized as a common and well-accepted method in radio telemetry studies, it is more useful for longer detection ranges (as with large mammals), where semi-permanent triangulation points can be established (particular hilltops, intersections, etc.), and where close tracking can affect an animal's behavior. Also, accuracy of triangulation relies heavily on compass bearings. Thus a 5-degree error can translate into miscalculating a target's location by many meters (possibly >100 meters). For those reasons, we chose to use triangulation only when situations (land access, etc.) made obtaining a location by any other means impractical, or when more than one bird was being tracked simultaneously.

Nest Monitoring

From late April through early July, hens were followed closely (usually daily) in anticipation of their nesting. Once a hen was thought to be nesting (same location for two consecutive days), field personnel would carefully move in closer to determine whether or not the bird was on a nest. Most times the bird could be seen in an incubating posture from as far as about 10 meters, and could be recorded as nesting without flushing her. Once a nest was confirmed (or assumed), a "marker" radio was placed two meters directly north of the nest. Marker radios were salvaged from dead birds or from birds that had transmitters replaced. They were washed thoroughly with dish detergent (to remove any blood or odor), rinsed, wrapped with camouflage duct tape, and placed into plastic bags with dried cattle dung (the odor of cattle dung being part of the total camouflage process). The marker radios could be put in place from several meters away by using the Yagi antenna at a full arm's extension. The placement of these marker radios eliminated needing any visual markers (flagging, etc.) to relocate a nest. Also, whether or not the hen was incubating could be determined from a safe distance (~100 meters), thus eliminating subsequent disturbance to her or the surrounding vegetation. Every three or four days, the technician who found the nest (only the same person who found the nest would monitor it in order to avoid accidental disturbance by someone unfamiliar with the nest) would come to within about 100 meters and dial up the hens' frequency and the marker radio's frequency, and take a compass bearing on each to confirm her location. After it was confirmed that a hen was no longer incubating on the nest (not present for two consecutive visits), the marker radio could be used to relocate the nest.

After a nest either failed or hatched, the entire nest and contents were photographed, and the egg remains were collected (nest success could be evaluated from the egg remains). Technicians would then return within 24 hours to complete vegetation sampling at and around the nest. For many nests, an "artificial" clutch consisting of four Ring-necked Pheasant (*Phasianus colchicus*) eggs and one clay egg (pliable, non-hardening modeling clay) were placed in the nest and a hair-catcher (dowel rod wrapped with double-sided tape) was suspended a few inches above the nest. We would continue monitoring this nest until this clutch was destroyed or until the artificial clutch had been in place for four weeks. From these artificial clutches, we could identify what predators potentially may be destroying actual prairie-chicken clutches (positive identification was possible from tooth impression in the clay egg and hairs stuck to the hair-catcher). Also, the patterns of egg destruction or consumption could then be compared to actual depredated prairie-chicken eggs, thereby allowing a reasonable level of confidence in determining the predator species. These artificial clutches were also collected and cataloged after they were destroyed.

Vegetation Sampling

Vegetation sampling was conducted monthly at randomly determined points. Sampling transects were 50 meters by 50 meters. We developed a methodology that was both comparable to methodology used at our other prairie-chicken research sites as well as to that used in research conducted by Davis et al (1981). From a predetermined point (located by using GPS units), sampling transects went 25 meters north, south, east, and west. At every meter along these transects, amount and type of canopy (a this site "canopy" is rarely over knee high) and basal cover were determined with a ¼-inch diameter contact rod. Davis et al. (1981), used a plumb bob, but we decided that the contact rod would yield the same results and would be more accurate, as it would be unaffected by wind, and, in addition, would be quicker. At five-meter intervals, the number and types of woody stems were counted for a one-meter radius, vegetation density was measured at three levels (<10 cm, 10-50 cm, and >50 cm), canopy height was measured, and maximum height within a one-meter radius was measured. Other data recorded included nearest water, nearest super-canopy woody vegetation, and type of habitat (native prairie, cultivated, Conservation Reserve Program [CRP] lands, etc.).

The same vegetation characteristics were measured at each nest immediately after it failed or hatched. Additionally, nest concealment ratings were assigned from one meter north, south, east, west, and above the nest (Ralph, et. al. 1993). The type, height, and density of vegetation at the nest also were measured, and the nest cup dimensions were measured.

Blood and Fecal Samples

Each time a bird was captured, about 1 cc of blood was taken from the ulnar vein (underside of the wing) for genetic analyses and for a survey for retroviruses. The first time a bird was captured, three drops of blood were placed into a tube containing lysis buffer for the genetics sampling. The remaining blood has placed into a 2 ml heparinized vial for the retrovirus surveys. For birds that were recaptured, the genetics sample was not repeated, but the retrovirus survey sample was collected, providing at least 30 days had passed since the last sample was taken. When birds were recaptured less than 30 days apart, no blood was collected on the recapture.

Blood samples were taken using a 3 cc syringe fitted with a 22-gauge needle. Some 25-gauge needles were kept on hand and substituted for the larger needles when individual birds had ulnar veins smaller than normal. After the 1 cc sample was taken, the collection site was dusted with powdered alum, and a cotton ball was pressed against the spot. Pressure was applied for two or three minutes, or until no more bleeding from the site occurred. After use, needles were detached from syringes, and both placed into containers labeled "Bio-Hazard Waste." Blood samples used for the retrovirus samples were placed in a freezer within two to three hours. Genetics samples needed only to be kept in a cool location and out of direct sunlight.

Once a month during gobbling seasons, fecal sample collections were made on each gobbling ground. This was accomplished by attempting to pick up at least 15 pieces of feces and placing them together in a plastic bag labeled with the latitude, longitude, and date. When a known bird was flushed during radio-tracking, the area was searched for feces, and if found, it was collected and labeled with the bird number, latitude, longitude, and date. These fecal samples were stored for anticipated future surveys for intestinal parasites.

Statistical Methods

All mapping was carried out using ArcView 3.2. Base maps are the U.S. Census Bureau's TIGER 98 files.

Home range analysis was performed using HRE: The Home Range Extension for ArcView (Rodgers and Carr 1998). Home ranges were determined using the adaptive kernel smoother. Data were first standardized using the unit variance method. The smoothing factor was chosen using the H_REF formula. Volume contouring was used to produce the polygons.

RESULTS AND DISCUSSION

Trapping

Results of trapping of prairie-chickens for spring 2000 are presented below. Trapping was carried on at seven trapping sites. These included three on the PCAs (two on Milnesand PCA and one on the North Bluitt PCA), one on the Weaver Ranch, and three on other private ranches. A total of 34 new cocks and 20 new hens were captured in spring 2000. Additionally, three cocks originally captured in 1999 were recaptured in spring 2000. Fifteen birds (14 cocks, one hen) captured in 1999 were still being tracked in spring 2000. Thus, a maximum of 69 (48 cocks and 21 hens) individual prairie-chickens were tracked in spring 2000.

Table 1. Lesser Prairie-Chickens captured in spring 2000 (includes three recaptured individuals originally captured in 1999). Figures in parentheses are percentage of each row.

Area	Males	Females	Total
All PCAs	12 (50%)	12 (50%)	24
North Bluitt PCA	4 (57%)	3 (43%)	7
Milnesand PCA	8 (47%)	9 (53%)	17
Private Ranches	22 (76%)	7 (24%)	29
Weaver Ranch	3 (75%)	1 (25%)	4
TOTAL	37 (65%)	20 (35%)	57

Survivorship

Annual and Seasonal Survivorship

A total of 26 (29.5%) of 88 birds radio-tagged from April 1999 to June 2000 have been found dead from predation or collisions with power lines. For all birds captured in 1999, 18 (53%) of 34 have been found dead and six (18%) are classified as missing.

Of the 23 birds that were captured in the Second Quarter of 1999 (April – June 1999, the first three-month period of this project), ten were known alive one year later, in the Second Quarter, 2000.

Table 2. Annual survivorship of the Lesser Prairie-Chicken cohort trapped and tagged in April – June 1999. Some of the birds known alive in April – June 2000 are known to have subsequently died. The maximum survivorship is calculated using only birds known to be dead and assuming that missing birds are alive. The minimum survivorship is calculated using the known-dead birds and assuming all missing birds to also be dead.

Category	Number at Beginning, April – June 1999	Known Alive in April – June 2000	Known Dead in April – June 2000	Missing in April – June 2000	Maximum Possible 1-year Survivorship	Minimum Possible 1-year Survivorship
All Birds	23	10	10	3	56.5	43.5
Cocks Only	17	10	5	2	70.6	58.8
Hens Only	6	0	5	1	16.7	0.00

The annual survivorship of all birds is probably around 50% (between 43.5% and 56.5%). This compares well with Campbell's (1972) estimate of 35% annual survivorship between 1962 and 1970 in eastern New Mexico. However, the survivorship of cocks and hens is very different. (Because the sample sizes are small, no statistical analysis was performed.) The cocks had an annual survivorship that was quite high, around 65%, while hens probably had a survivorship of around 10%. In fact, no hens were known to have survived one year. The sample size of hens was very small, however, only six birds, and this low survivorship figure may reflect only chance events and not the true survivorship of hens.

In each of five different months (October 1999, January 2000, March 2000, May 2000, and June 2000) four dead birds were recovered. The number of birds found dead in other months ranged from zero to two.

Table 3. Number of birds killed, by month.

Month	All Birds Killed	Hens Killed	Cocks Killed
1999			
April	1		1
May	2	2	
June			
July			
August	1		1
September			
October	4		4
November	1	1	
December			
2000			
January	4	2	2
February	1		1
March	4		4
April			
May	4	2	2
June	4	1	3

When combined with our mortality data from our Oklahoma Lesser and Greater Prairie-Chicken research sites (134 mortalities), 26% of all mortalities occurred in May, while 43% of hen mortalities occurred in May. This is probably due to the vulnerability of incubating hens to predators. Male mortality peaks during the months when gobbling activity is also at its peak; 39% of all male mortalities have occurred in the months of March, April, and May.

When months are aggregated into quarter-years, comparison can be made with the number of birds known to be alive during the quarter.

Table 4. Quarterly maximum survivorship. Because of small sample sizes, survivorship of cocks and hens was not calculated. Maximum survivorship is calculated using only birds known to be dead and assuming that all missing birds are alive.

Period	Number of Birds Known Alive	Number of Birds Known Dead	Maximum Possible Quarterly Survivorship
1999			
April – June	23	3	87.0
July – Sept.	29	1	96.6
Oct. – Dec.	27	5	81.5
2000			
Jan. – March	37	8	78.4
April – June	64	8	87.5

The only two quarters in which the project has been active in both years, the April – June quarter, shows a very similar maximum survivorship rate of 87.0% and 87.5%. Survivorship was highest in the July – September quarter of 1999, and was lower in the fall and lowest in the winter. The latter part of the winter corresponds with the gobbling season.

Mortality Factors

In general, mortality has been attributed to mammalian predators, avian predators, and fence / power line collisions. Although it is assumed that the causes of mortality occur in the order listed, exact ratios have yet to be determined (this requires thorough examination of each carcass as well as some educated interpretation in order to distinguish predation from scavenging). Furthermore, this is a very complicated subject. For example, Greater Prairie-Chicken researcher John Toepfer a Greater Prairie-Chicken in Wisconsin killed by a power line collision. Within hours it was seen scavenged by a Red-tailed Hawk, dropped and hanging on a barbed wired fence, and finally found and carried away by a farm dog (Toepfer 1988). The human observer locating this dead bird would logically derive a different conclusion about the cause of death depending on the stage of scavenging at which the carcass was recovered.

Counting recaptured birds, we have had over 150 captures of Lesser Prairie-Chickens in New Mexico. One hen in 1999 died during processing due to undetermined causes. (In over 800 captures of Lesser and Greater Prairie-Chickens in Oklahoma and New Mexico, we have had only four trapping casualties.) Aside from the aforementioned trapping casualty, we have experienced no other trapping related mortality in New Mexico. Two birds were found dead within one week of capture: one of these was found three days after capture (in April 1999); the second bird was found six days after capture (in March 2000). A total of four other birds were found dead within one month of capture, ranging from 15 to 30 days after capture. Two (both cocks) of the latter mortalities occurred in October 1999, when two additional birds radioed in spring of 1999 were also found dead. The other two birds found dead within one month of capture were hens in May 1999 and May 2000, which, as mentioned earlier, is the peak month for hen mortality. Therefore, we feel reasonably sure that these mortalities were likely not trapping related.

Movements and Home Ranges

The maximum distance moved by the prairie-chickens can give an estimate of the home range size that might be required. To measure this, we selected only birds during the period from 1 March to 30 June 2000 that were still alive at the end of the period. In addition, because many birds are recorded repeatedly at only a few locations, such as when they are on the lek or when hens are incubating a nest, we chose to analyze only birds for which there were at least four non-lek and non-nest (for hens) locations. The maximum distance moved was measured as the greatest distance between two points, including the lek and nest locations, where the bird was recorded. The result can be seen in the table below.

Table 5. Maximum movement distances for Lesser Prairie-Chickens from 1 March to 30 June 2000. Only birds which were still alive at the end of the period, and for which there were at least four non-lek and non-nest locations are given. All distances are in km.

Sex	Mean	Minimum	Maximum	s	n
Hens	1.88	0.71	2.77	1.06	3
Cocks	2.90	0.55	6.62	1.98	14

The area of home ranges was measured for the same set of birds as the maximum movement distance, that is, only those with at least four non-lek, non-nest locations during the period from 1 March to 30 June 2000 and which were still alive at the end of the period. These measurements are expressed in square km in the table below. One cock, bird number 412, had a much larger home range than any other bird, although its maximum movement distance was not the highest. This can occur if a bird moves frequently in many directions, thus producing a large, roughly circular home range, while another bird may move farther but in a straight line, producing a narrow range with less area. Because bird number 412 was unusual, data are presented in the table both including and excluding that individual.

Table 6. Home range areas for Lesser Prairie-Chickens from 1 March to 30 June 2000. Only birds which were still alive at the end of the period, and for which there were at least four non-lek and non-nest locations are given. All areas measured in square km. For explanation why bird number 412 was excluded, see text above.

Sex	Mean	Minimum	Maximum	s	n
Hens	5.25	1.30	9.89	4.34	3
Cocks	9.57	0.31	53.38	14.06	13
Cocks without #412	5.91	0.31	14.43	5.15	12

Fig. 2. Home ranges of all three hens for which home range could be calculated.

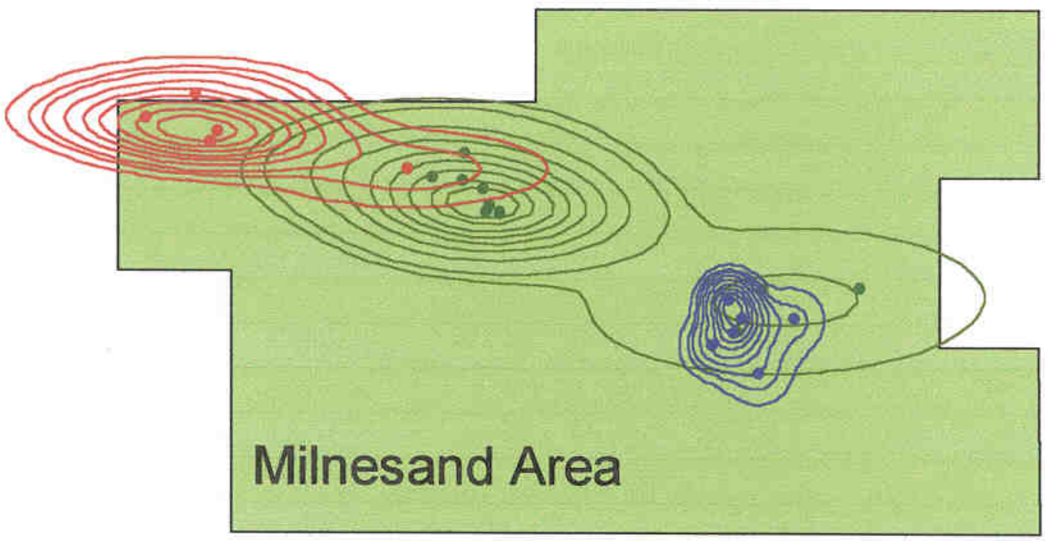
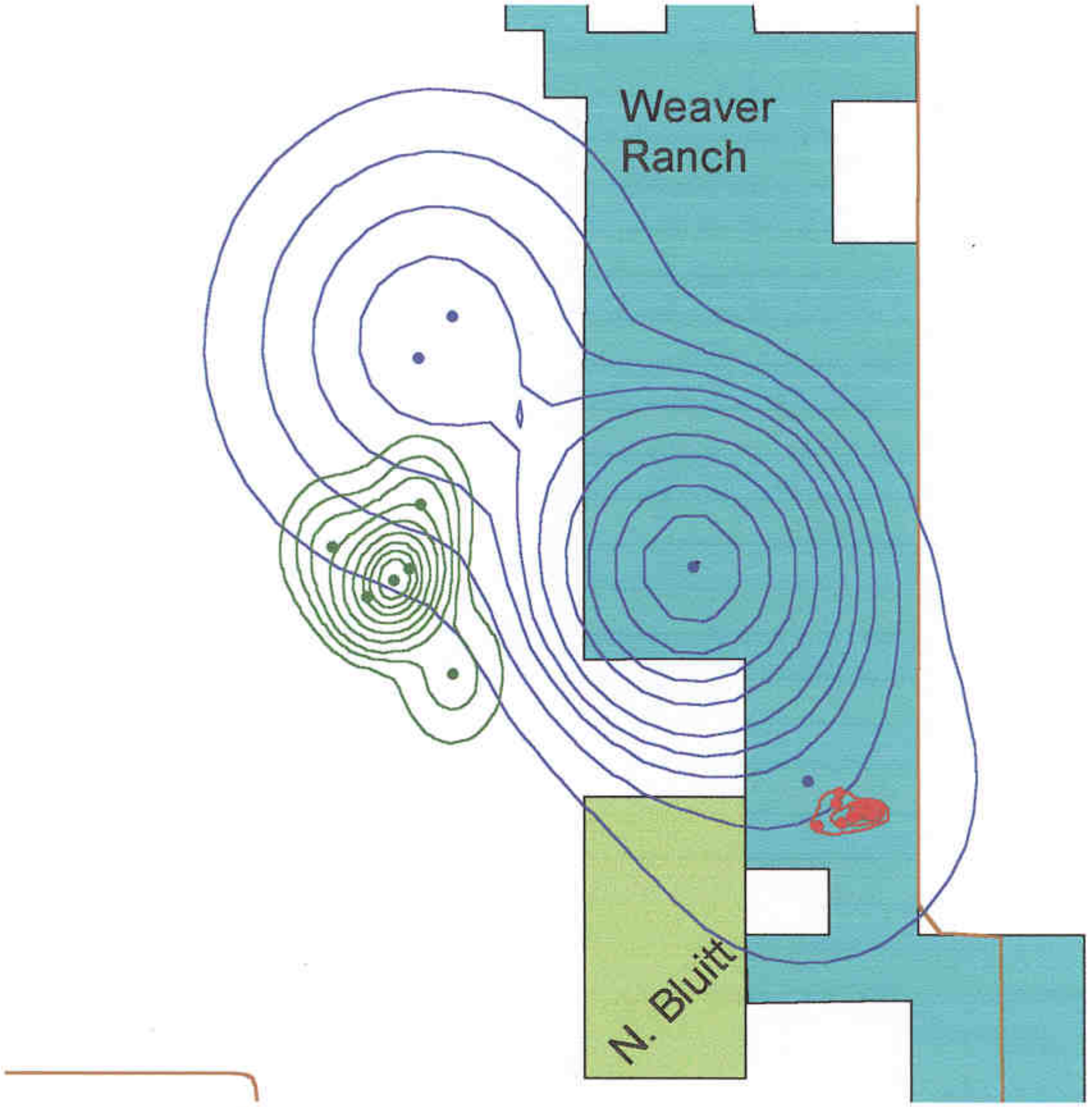


Fig. 3. Home ranges of three cocks, showing the variation of home range sizes. The smallest range size is bird number 453 (red); the largest range size is bird number 412 (blue); and a range near the average size is represented by bird number 487 (green).



The average distance moved by cocks was greater than that of hens (Table 5), but still is only 2.90 km (1.80 mi). The area of the home ranges of both hens and cocks (Table 6) was similar, more than 5 sq. km (about 2 sq. mi), as long as bird number 412 is excluded. If bird 412 is included, the average home range size of the cocks is nearly twice that of the hens.

These distances and home range sizes suggest that areas such as the South Bluitt PCA, with an area of about 2.6 sq. km and a maximum corner-to-corner length of 2.3 km, or the North Bluitt PCA with an area of about 5.2 sq. km and a corner-to-corner length of 3.6 km, probably would not serve to provide the entire home range for most Lesser Prairie-Chickens. The much larger Milnesand PCA, however, with an area of about 42 sq. km and a corner-to-corner length of about 8.4 km probably could provide the range for not only one but several non-overlapping ranges. The larger area is probably necessary, as well, because while most birds have home ranges less than 10 sq. km, a few birds, such as bird 412, may require much more space.

Nesting

Nest Success

We experienced some difficulty tracking birds with frequencies above 149.900 MHz, due to a considerable amount of radio interference; three hens had received transmitters in this frequency range before the problem was evident. These radio frequency problems and limited land access in some areas have contributed not only to birds being classified as "missing," but also to difficulty in finding nests for all radioed hens.

In both 1999 and 2000, hens were tracked (one in 1999 and four in 2000) that were never found to be on nests. Perhaps some of these hens experienced failures during the egg laying stage or during early incubation before we had a chance to locate the nests. Additionally, one hen in 1999 and three hens in 2000 were found dead before any nest was found. It is possible that these hens were killed on nests and carried away from the nest by predators (one hen was found killed on a nest in 1999).

Three nests from radioed hens were located in 1999. One (33%) of these was successful. The Mayfield hatching success rate can be calculated using only two of the nests, and yields a rate of 50.4% hatching success.

Four (57%) of seven nests found in 2000 were successful. Two of the failed nests failed on the day after they were discovered, giving only one exposure day for each. This greatly reduces the Mayfield estimate. The Mayfield hatching success probability estimate for these nests is 40.7%.

Combining the nests from both years (for a total of nine nests), the Mayfield hatching success rate is 43.5%. This is a very high number, much higher than most hatching or nest success estimates for Lesser Prairie-Chickens or other ground-nesting birds, and probably reflects chance events, rather than true, long-term hatching success rate. The usual nest success rate averages 28% (Giesen 1998), although with a range among ten different researchers from 0 – 67%.

Causes of Nest Failures

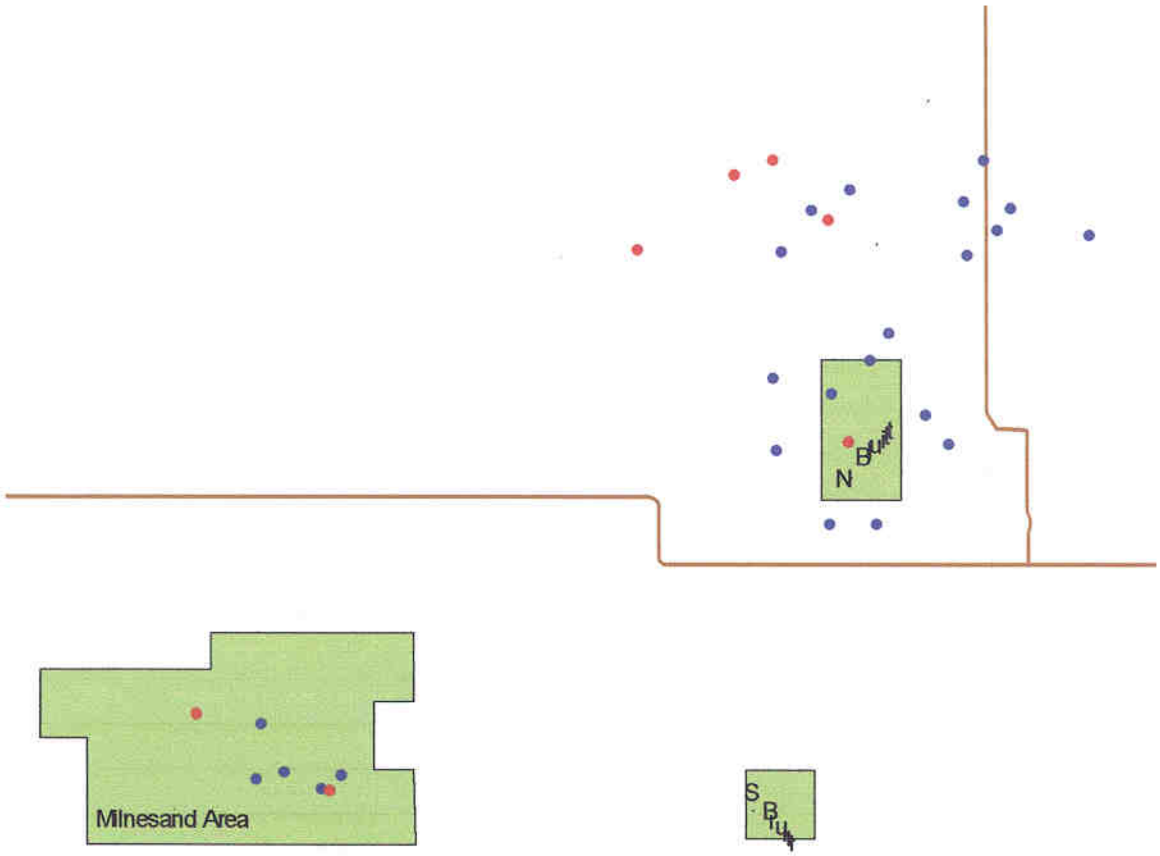
Predation accounted for all nest failures in both 1999 and 2000. In all but one case, predation was attributed to mammals. The only exception was a nest found in 2000, where the hen was incubating only one egg when the nest was discovered. She apparently abandoned this egg, but when it was confirmed that she was no longer incubating the egg, it was candled and shown to have a fairly well developed embryo. The only reasonable conclusion we could make about this nest was that an unknown predator had removed the rest of the eggs prior to discovery of the nest by our personnel. If the hen had merely abandoned the nest during egg-laying, the egg should have shown no development. As mentioned earlier, one hen was killed on the nest in 1999 by a mammalian predator. For 73 Greater Prairie-Chicken nests found in Oklahoma between 1997 and 2000, hens were killed on six (8%) of the nests.

Nesting Habitat

To make comparisons of nesting habitat, we measured the vegetation at a point centered on the nest. All nest vegetation measurements were made after the nest had hatched or had failed, so that we did not disturb the nest when it was active. This may cause some bias, because the vegetation characteristics that were present at the time the hen chose the nest site may not be present when the vegetation data were finally collected, after up to four weeks of incubation. However, this is an unavoidable problem.

The vegetation measurements at a nest were made in exactly the same way as at those points not at a nest. To make the nest and non-nest vegetation measurements most comparable, we used vegetation measurements collected at non-nest points only within roughly the same time span as measurements made at the nests. This therefore reduces bias as much as possible, by equalizing the amount of growth by the vegetation, amount of time areas have been grazed by cattle, etc. Of seven nests for which we have vegetation data, all measurements were obtained between 24 May and 12 June 2000. We compare those vegetation measurements with non-nest points from a week before that period to a week after, that is, from 17 May to 19 June 2000. This includes 23 vegetation points. A map showing the locations of the nest and non-nest locations is given below (Fig. 4).

Fig. 4. Locations of vegetation characterization points. Nest locations are in red; non-nest locations are in blue. Green areas are the Prairie-Chicken Areas.



The results of the comparisons are presented in the following tables.

Table 7. Habitat type categories of the vegetation characterization points, by nest and non-nest points. Comparing the proportion of Native Prairie vs. the other four categories combined (Wheat / Rye / Oat field + Corn field + Native Mix CRP field + Other CRP field) by whether the point is a nest or not using a chi-square test, indicates that the difference in habitat type category between nests and non-nests is not significant (χ^2=1.41, df=1, p=0.236).

	Non-Nest		Nest	
Type	Number	Percent	Number	Percent
Wheat / Rye / Oat cultivated field	1	4	0	0
Corn cultivated field	1	4	0	0
Native Mix CRP field	1	4	0	0
Other CRP field	1	4	0	0
Native Prairie	19	84	7	100
TOTAL	23		7	

Table 8. Grazing type categories of the vegetation characterization points, by nest and non-nest points.

	Non-Nest		Nest	
Type	Number	Percent	Number	Percent
Cattle grazing	6	26	2	29
None	17	74	5	71
TOTAL	23		7	

Table 9. Vegetation characteristics of the vegetation characterization points, by nest and non-nest points. The t-test value, degrees of freedom, and probability are given only for those tests where p<0.100.

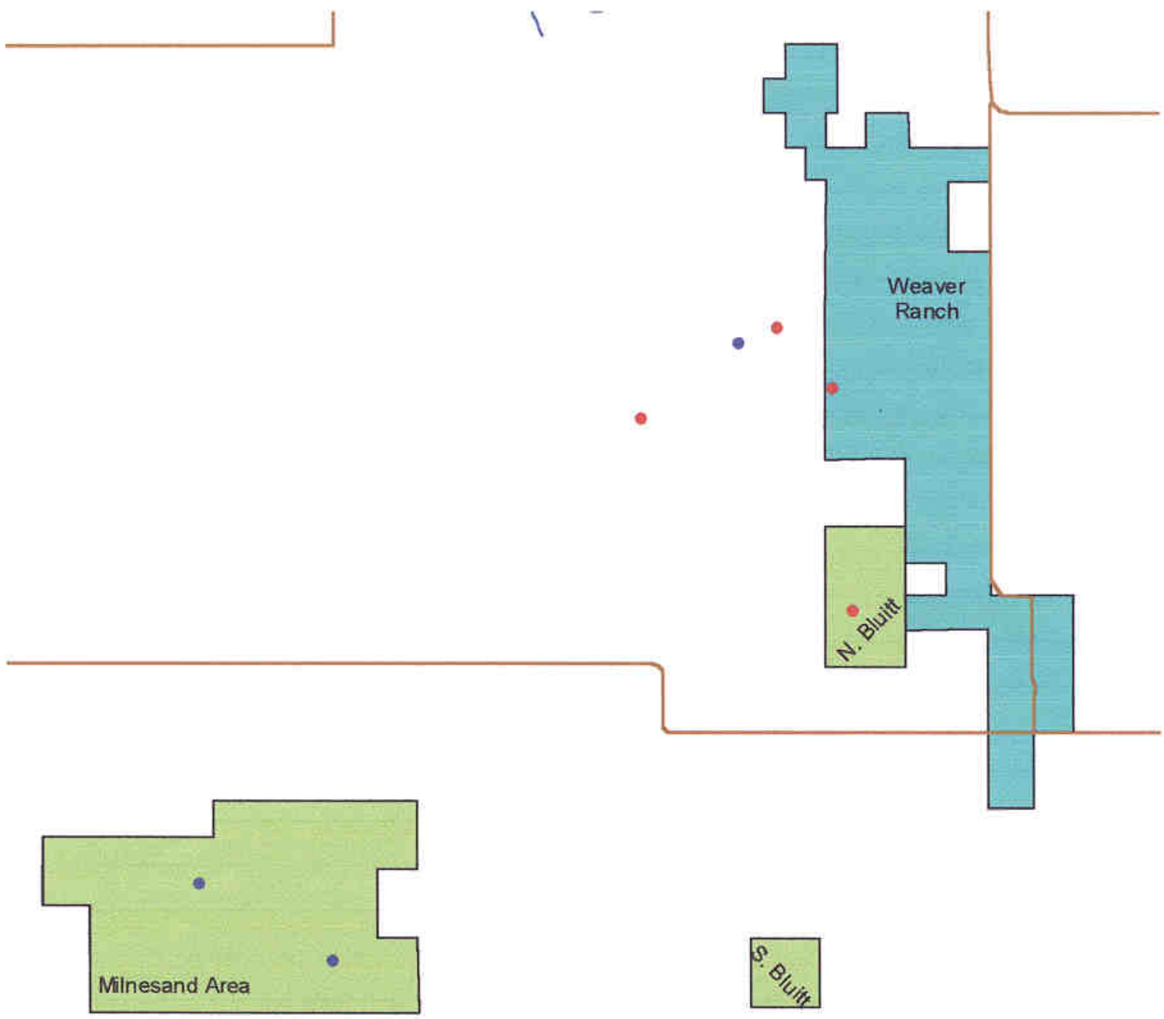
Characteristic	Non-Nest	Nest	t, df, p
Canopy Cover			
Shinnery oak	2.72	4.11	n.s.; t=-1.58, df=16, p=0.067
Tallgrass	4.75	5.86	n.s.
Sand sagebrush	0.15	0.36	n.s.
Shortgrass	0.04	0.04	n.s.
Mesquite	0.04	0.00	n.s.
Other	1.96	1.11	n.s.; t=1.37, df=25, p=0.092
Basal Cover			
Shinnery oak	0.37	0.71	n.s.
Tallgrass	2.60	1.71	n.s.; t=1.63, df=26, p=0.057
Sand sagebrush	0.03	0.14	n.s.
Shortgrass	1.49	0.46	*; t=1.93, df=23, p=0.033
Mesquite	0.00	0.00	n.s.
Other	0.84	0.36	*; t=1.93, df=27, p=0.032
Maximum Veg. Ht.	86.66	102.19	**; t=-3.14, df=23, p=0.002
Canopy Height	19.15	20.24	n.s.
Density			
Less than 10 cm	1.53	1.01	*; t=1.83, df=15, p=0.044
10 to 50 cm	1.66	1.94	n.s.
Greater than 50 cm	0.23	0.19	n.s.
No. Woody Stems			
Shinnery oak	32.70	63.86	***; t=-4.24, df=27, p<0.000
Sand sagebrush	0.30	1.82	n.s.; t=-1.64, df=6, p=0.076
Mesquite	0.02	0.00	n.s.
Other	1.76	0.68	*; t=1.94, df=25, p=0.032

The results of these comparisons indicate that Lesser Prairie-Chickens in the area studied were selecting areas for nesting with a greater amount of shinnery oak stems, lower grass density in the near-ground level (as measured by rod contacts and because both shortgrasses and tallgrasses are avoided), and avoiding areas with other woody plant species (broom snakeweed, yucca, cholla, etc.). They prefer areas with taller maximum vegetation height. As with shinnery oak, the birds also tend to prefer areas with more sand sagebrush, but the amount of sand sagebrush is quite small at both nests and non-nest sites.

The maximum vegetation height we recorded in the vicinity of the nest (102 cm) is higher than that recorded immediately at the nest by other researchers (43-81 cm; Giesen 1998). Otherwise, nest characteristics recorded in this study seem typical of those reported by others in Giesen (1998).

Besides determining in what habitat the prairie-chickens place their nests, it is important to determine in what habitat those nests are successful. Of seven nests, four were successful and three failed. Their locations can be seen in Fig. 5.

Fig. 5. Locations of the successful and unsuccessful nests, Spring 2000. Unsuccessful nests are indicated by blue points; successful nests are in red. Green areas are the PCAs, aquamarine area is the approximate boundaries of the Weaver Ranch, and white areas are private ranches.



Of the four successful nests, one was on the Weaver Ranch, one on the North Bluitt PCA, and two were on other private ranches. Both of the nests on the Milnesand PCA were unsuccessful, as was one nest on a private ranch. Because of the small sample size, no statistical comparisons were made between the habitat characters of the successful and failed nests.

All seven of the nests were on the Native Prairie Habitat type (see Table 7). Most of the nests were on ungrazed lands. However, this may be biased in that grazing is not allowed on the PCAs, and therefore the prairie-chickens on the PCAs could not have "chosen" a nest site on grazed land. One successful nest and one unsuccessful nest were on grazed range.

The comparison of the habitat characters can be seen in the table below.

Table 10. Comparison of habitat characteristics at successful and unsuccessful nests in spring, 2000. Because of small sample sizes, no statistical analysis was performed. Direction of Trend indicates whether successful nests were higher (+), lower (-), or the same (=) as unsuccessful nests.

Characteristic	Successful Nests	Unsuccessful Nests	Direction of Trend
Canopy Cover			
Shinnery oak	4.81	3.17	+
Tallgrass	5.94	5.75	+
Sand sagebrush	0.63	0.00	+
Shortgrass	0.06	0.00	+
Mesquite	0.00	0.00	=
Other	1.19	1.00	+
Basal Cover			
Shinnery oak	0.69	0.75	-
Tallgrass	1.44	2.08	-
Sand sagebrush	0.25	0.00	+
Shortgrass	0.44	0.50	-
Mesquite	0.00	0.00	=
Other	0.44	0.25	+
Maximum Veg. Ht.	102.00	102.33	-
Canopy Height	23.00	16.57	+
Density			
Less than 10 cm	1.06	0.93	+
10 to 50 cm	2.29	1.48	+
Greater than 50 cm	0.28	0.07	+
No. Woody Stems			
Shinnery oak	62.10	66.22	-
Sand sagebrush	1.94	1.67	+
Mesquite	0.00	0.00	=
Other	0.68	0.68	=

The general pattern shown from this table is that successful nests had greater canopy cover and less basal cover. This is somewhat complicated by the greater vegetation density at all levels, including the less than 10 cm category, although without statistical analyses it is difficult to determine which of these is important. However, the proportional difference in the density at that level is much less than the difference in the 10 to 50 cm and greater than 50 cm levels.

The canopy cover of shinnery oak was apparently higher for the successful nests, but the number of stems of the oak was about the same, possibly even lower, in the vicinity of the successful nests. This suggests that the health of the shinnery oak may be an important factor, not just its presence.

Thus, it appears that successful nests probably were placed in a fairly open space beneath a relatively heavy canopy. Giesen (1998) reported that successful nests were positively correlated with height and density of residual grasses, nests within or adjacent to tall bunchgrasses or shrubs were more likely to be successful, and successful nests were associated with more litter and less bare ground. Our data generally support these earlier conclusions. It is not clear, however, how our data on basal cover correspond to Giesen's (1998) information on litter and bare ground.

Nest Location Relative to Lek

For six of the seven nests, the hen was recorded only at one lek. This does not mean that the hens did not visit more than one lek, but only that they were never detected on more than one.

Those hens placed their nests at an average distance of 0.96 km (0.60 mi; s = 0.23 km) from the lek they were known to have visited. The nest placed closest to the lek was 0.68 km (0.42 mi), and the farthest was 1.29 km (0.80 mi). These figures generally agree with those reported in Giesen (1998).

Habitat Use at Non-Nesting Locations

Although nesting habitat is very important to the prairie-chickens, information on the general habitat used by the birds is also important. We compared vegetation characteristics at locations used by the prairie-chickens ("prairie-chicken locations") and at points not used by prairie-chickens ("non-prairie-chicken locations"). These locations do not include gobbling grounds or nest sites. PLEASE NOTE THAT THE TERMS "PRAIRIE-CHICKEN LOCATIONS" AND "NON-PRAIRIE-CHICKEN LOCATIONS" USED HERE REFER TO VEGETATION POINTS.

"Prairie-chicken locations" were vegetation points chosen to be near (< 0.4 km or 0.25 mi) sites where individual Lesser Prairie-Chickens had been tracked. The average distance of the nine "prairie-chicken locations" from the nearest place where a bird had been tracked was 148 m (about 0.09 mi). "Non-prairie-chicken locations" were vegetation points that were farther than 0.4 km from the nearest point where a bird had ever been tracked. Of the prairie-chicken locations, four were on PCAs (two on the Milnesand and two on the North Bluitt PCAs), two were on the Weaver Ranch, and three were on other private ranches. To be comparable with other vegetation comparisons, only locations from the period from 1 May to 30 June 2000 were used in the analysis.

It is likely that birds may be in the vicinity of the non-prairie-chicken locations from time to time. It is also possible that prairie-chickens with no radio tags, and therefore not being tracked by us, may be occasionally or frequently located near points we identify as "non-prairie-chicken locations." Because the "true" distribution of all prairie-chickens, both tagged and with no radio tags, cannot be known, this bias is not avoidable. The results are presented in the tables, below.

Table 11. Habitat type categories of the vegetation characterization points, by prairie-chicken and non-prairie-chicken locations. Comparing the proportion of Native Prairie vs. the other four categories combined (Wheat / Rye / Oat field + Corn field + Weeping lovegrass + Native Mix CRP field + Other CRP field + Other / Unknown) by whether the point is a prairie-chicken location or not using a chi-square test, indicates that the difference in habitat type category between nests and non-nests is not significant (χ^2=1.31, df=1, p=0.252).

	Prairie-chicken Locations		Non-Prairie-chicken Locations	
Type	Number	Percent	Number	Percent
Wheat / Rye / Oat cultivated field	0	0	2	4
Corn cultivated field	0	0	1	2
Weeping lovegrass	0	0	1	2
Native Mix CRP field	0	0	1	2
Other CRP field	0	0	1	2
Native Prairie	9	100	47	86
Other / Unknown	0	0	1	2
TOTAL	9		54	

The prairie-chicken locations were all on native prairie habitat, while 14% of non-prairie-chicken locations were on cultivated and other types of habitats. However, this difference was not significant.

Table 12. Grazing type categories of the vegetation characterization points, by prairie-chicken locations and non-prairie-chicken locations. This may be biased in that some non-prairie-chicken vegetation locations were on the Milnesand PCA, which does not allow grazing.

	Prairie-chicken Locations		Non-Prairie-chicken Locations	
Type	Number	Percent	Number	Percent
Cattle grazing	0	0	15	28
None	9	100	39	72
TOTAL	9		54	

All nine prairie-chicken locations were on ungrazed land, while only 72% of the non-prairie-chicken locations were ungrazed. This difference may be biased, however, because the Milnesand PCA and other PCAs do not allow grazing, so the birds could not have been located on grazed areas on those PCAs.

Table 13. Vegetation characteristics of the vegetation characterization points, by prairie-chicken locations and non-prairie-chicken locations. The t-test value, degrees of freedom, and probability are given only for those tests where p<0.100.

Characteristic	Prairie-chicken Locations	Non-Prairie-chicken Locations	t, df, p
Canopy Cover			
Shinnery oak	5.31	2.32	**; t=3.31, df=10, p=0.004
Tallgrass	5.17	4.77	n.s.
Sand sagebrush	0.47	0.31	n.s.
Shortgrass	0.03	0.10	n.s.
Mesquite	0.00	0.07	**; t=-2.68, df=53, p=0.005
Other	0.47	1.63	***; t=-3.76, df=61, p=0.000
Basal Cover			
Shinnery oak	0.75	0.50	n.s.
Tallgrass	1.86	2.19	n.s.
Sand sagebrush	0.00	0.06	***; t=-3.46, df=53, p=0.001
Shortgrass	0.39	1.74	**; t=-3.06, df=60, p=0.002
Mesquite	0.00	0.01	n.s.
Other	0.28	0.68	**; t=-2.67, df=44, p=0.005
Maximum Veg. Ht.	94.41	85.73	n.s.; t=1.66, df=20, p=0.056
Canopy Height	23.16	17.59	***; t=3.42, df=29, p=0.001
Density			
Less than 10 cm	1.16	1.47	n.s.; t=-1.39, df=14, p=0.093
10 to 50 cm	2.08	1.53	*; t=2.55, df=18, p=0.010
Greater than 50 cm	0.23	0.16	n.s.
No. Woody Stems			
Shinnery oak	67.72	36.04	***; t=4.36, df=28, p=0.000
Sand sagebrush	0.49	0.98	n.s.
Mesquite	0.00	0.05	*; t=-1.92, df=53, p=0.030
Other	0.47	1.35	**; t=-3.19, df=60, p=0.001

Lesser Prairie-Chickens appear to prefer areas with greater canopy cover by shinnery oak, greater maximum vegetation and canopy heights, greater density of vegetation in the mid-level 10 to 50 cm above the ground (probably related to canopy height), and with a greater number of stems of shinnery oak (probably related to the amount of shinnery oak in the canopy). In contrast, they seem to prefer areas with less mesquite and other woody plants in the canopy, in general less vegetation in the basal layer, fewer stems of mesquite and other woody species.

A comparison of these "preferred" characteristics with those on the PCAs, the Weaver Ranch, and other private ranches, can be seen below.

Reticuloendotheliosis Survey

Reticuloendotheliosis (RE) is a disease known to infect a number of bird species, including domestic chickens (*Gallus gallus*), ducks, quail, pheasants, and domestic Turkeys (*Meleagris gallopavo*; Bagust 1993, Witter 1997). Recently, it has also been found to cause mortality in captive Attwater's Prairie-Chickens (*Tympanuchus cupido attwateri*; Drew et al. 1998). Because of the serious effects that RE has shown on captive Attwater's Prairie-Chickens (Drew et al. 1998), we became interested in determining if RE might be one potential cause for the declines of prairie-chickens in areas where habitat remains. Therefore, we decided to survey wild prairie-chickens to determine if RE might be present in the wild populations.

RE can be caused by any one member of a family of retroviruses, including reticuloendotheliosis viruses REV-T, REV-A, spleen necrosis virus (SNV), chick syncytial virus (CSV), and duck infectious anemia virus (Bagust 1993), and several non-classified viruses (Ritchie et al. 1994). The REV-T form appears to be responsible for the most acute oncogenicity, while other viruses and strains in the group appear to be responsible for runting disease (poor growth, abnormal feathering, immunodepression) and chronic neoplastic disease (Witter 1997), which may also be lethal.

We collected blood from every Lesser Prairie-Chicken captured in 1999 and 2000. Of the 184 samples (including three obtained from Lesser Prairie-Chicken researchers in western Kansas in 1999; see Table 14) all were negative for the presence of RE viruses.

Table 14. Sources and number of blood samples from Lesser Prairie-Chickens surveyed for presence of RE viruses. All samples were negative for the presence of RE viruses.

	MALES		FEMALES	
STATE	1999	2000	1999	2000
Kansas	3			
Oklahoma	42	37	3	20
New Mexico	22	34	5	18
TOTAL BY YEAR	67	71	8	38
TOTAL BY SEX	138		46	
TOTAL	184			

Our research with Greater Prairie-Chickens in Oklahoma and research efforts by Texas A&M University with Attwater's Prairie-Chickens in Texas indicates that reticuloendotheliosis does occur in other forms of prairie-chickens and is a potential mortality factor warranting further investigation. However, it does not appear to be a serious threat in Lesser Prairie-Chickens.

Genetics

From each blood sample collected, three drops were immediately placed into lysis buffer solution for genetic analyses. Ronald Van Den Bussche at Oklahoma State University conducted the analyses of samples collected in 1999. Samples were analyzed for heterozygosity at six nuclear microsatellite loci. These are the same loci analyzed by Westemeier et al. (1998); therefore the results of our study can be compared with those of Westemeier. In addition, Van Den Bussche has been sequencing a portion of the mitochondrial D-loop, which should provide additional information on genetic mixing within the Lesser Prairie-Chicken.

According to a verbal report by Van Den Bussche, the amount of genetic diversity between our New Mexico and Oklahoma sites is comparable with results from Greater Prairie-Chicken genetic analysis conducted in Kansas, Nebraska, and Minnesota (Bouzat et al. 1998). A larger sample size and further analyses are needed to assess whether genetic depression within New Mexico prairie chickens is a problem (samples collected in 2000 have not yet been analyzed, and we are searching for funding to accomplish this as soon as possible).

Comparison of Prairie-Chicken Areas and Private Ranches

Prairie-chicken Population Density

It is very difficult to estimate the population density or even to provide an index to density from our present data. In the following table are data on the numbers of birds recorded at the gobbling grounds through the trapping season of 2000.

Table 15. Numbers of birds recorded in 2000 at gobbling grounds, by month and by location. The average is the average for the month of the *maximum recorded on a particular day*. The maximum value given is the maximum value recorded at the lek for the entire month. The No. Days is the number of days data were recorded at the lek.

	PCAs			Weaver Ranch	Other Private Ranches			
Lek ID	1	M1	M2	6	4	5	7	TOTAL
February								
Average	8.5					6.4		
Max.	9					10		19
No. Days	2					5		7
March								
Average	7.0					10.0		
Max.	7					11		18
No. Days	1					4		5
April								
Average	8.0	16.0	7.3	8.5	7.8		4.0	
Max.	10	20	10	9	10		8	77
No. Days	3	2	4	2	5		2	18
May								
Average		14.0					4.0	
Max.		14					4	18
No. Days		1					1	2

April was the month with the greatest number of days spent at gobbling grounds recording data. In addition, during April, we recorded data at six of the seven leks at which data were recorded. Therefore, using the maximum numbers from April plus data for Lek 5 from March, an estimate of 87 birds (77 from April + 10 from Lek 5 in March) can be derived.

Because it is not known if other leks or how many other leks existed in the study area (or its subunits, such as the PCAs and ranches), this number cannot be used to calculate a density of birds or to compare bird densities on the PCAs and ranches.

General Vegetation Structure

Only the non-nest, that is, randomly-selected, vegetation points measured between 1 May and 30 June 2000 are included in this comparison, to make them comparable to those described in the section on nesting habitat, above. Five vegetation points were measured on the Milnesand PCA and five on the North Bluitt PCA, for a total of ten on the PCAs. A total of 28 vegetation points were measured on private ranches in the study area not including the Weaver Ranch. Because the Weaver Ranch probably is managed in a significantly different way, it will be treated as a third category. In May and June, 18 points were measured on the Weaver Ranch.

Fig. 6. Locations of the non-nest vegetation characterization points from 1 May to 30 June 2000. Vegetation points are in blue. Green areas are the PCAs, aquamarine area is the approximate boundaries of the Weaver Ranch, and white areas are private ranches.

Because of the likelihood that the Weaver Ranch is not comparable to other ranches in the area owing to its unique management system, comparisons will be made generally only between the vegetation points on the PCAs and on the other ranches. We will make comparisons of vegetation characteristics only on the characteristics that were shown to be significant or nearly significant in the analysis above on nest habitat; those vegetation characteristics are probably the ones important to the prairie-chickens.

The results of the comparisons are presented in the following tables. In the tables, "PCAs" refers to the points measured on the Milnesand and North Bluitt PCAs. "Ranches" refers to points on the private ranches NOT including the Weaver Ranch, and "Weaver" refers to points on the Weaver Ranch.

Table 16. Habitat type categories of the non-nest vegetation characterization points, compared by their locations on the PCAs, private ranches, and the Weaver Ranch.

Type	PCAs		Ranches		Weaver	
	Number	Percent	Number	Percent	Number	Percent
Wheat / Rye / Oat cultivated field	0	0	1	4	1	6
Corn cultivated field	0	0	1	4	0	0
Weeping Lovegrass	0	0	1	4	0	0
Native Mix CRP field	0	0	0	0	1	6
Other CRP field	0	0	0	0	1	6
Native Prairie	10	100	24	84	15	82
Other / Unknown	0	0	1	4	0	0
TOTAL	10	100	28	100	18	100

Table 17. Grazing type categories of the vegetation characterization points, by their locations on the PCAs, private ranches, and the Weaver Ranch.

Type	PCAs		Ranches		Weaver	
	Number	Percent	Number	Percent	Number	Percent
Cattle grazing	0	0	11	39	2	11
None	10	100	17	61	16	89
TOTAL	10	100	28	100	18	100

Table 18. Comparison of vegetation characteristics between points on the PCAs and private ranches (not including the Weaver Ranch). The t-test value, degrees of freedom, and probability are given only for those tests where p<0.100. Comparisons are only made on those characteristics that were significant or nearly significant in Table 9, above (analysis on nest habitat); those vegetation characteristics are probably the ones important to the prairie-chickens for nesting.

Characteristic	PCAs	Ranches	T, df, p
Canopy Cover			
Shinnery oak	4.63	2.13	**; t=2.80, df=14, p=0.007
Other	1.40	1.47	n.s.
Basal Cover			
Tallgrass	2.48	1.96	n.s.
Shortgrass	0.33	1.57	**; t=-2.72, df=29, p=0.005
Other	0.45	0.57	n.s.
Maximum Veg. Ht.	102.58	78.40	***; t=3.77, df=26, p<0.000
Density			
Less than 10 cm	1.30	1.27	n.s.
No. Woody Stems			
Shinnery oak	44.36	33.33	n.s.
Sand sagebrush	0.50	0.26	n.s.; t=1.35, df=19, p=0.097
Other	1.80	1.13	n.s.

These results show that the ranches had less canopy cover by shinnery oak, more basal cover by shortgrasses, and a greater vegetation height. Although not significant in all instances, the general pattern is that the PCAs generally had more vegetation than the ranches at all levels, although the exact composition of the vegetation differs somewhat.

Availability of General Prairie-Chicken Habitat

The habitat type of all vegetation points on the PCAs (Table 16), that is Native Prairie, is the type that seems to be "preferred" by the prairie-chickens when away from a lek and not on a nest (Table 11). The birds also seemed to "prefer" areas that were not being grazed (Table 12), and the PCAs are, of course, not grazed.

Comparison of the vegetation characteristics in Table 18 with those of the general vegetation "preferred" by the prairie-chickens in Table 13 indicates that the vegetation on the PCAs is probably more similar to that selected by the birds than is that on the private ranches. Shinnery oak canopy cover was "preferred" by the birds, and was greater on the

PCAs, as was maximum vegetation height. Basal shortgrass cover was "not preferred" by the birds, and was lower on the PCAs than on the ranches.

A comparison of these characteristics between the PCAs and the Weaver Ranch can be seen below, on page 40.

Availability of Nesting Habitat

Comparison of the results in Table 18 with those of the nest habitat selected by the prairie-chickens (Table 9) indicates that the vegetation on the PCAs is probably more similar to the nesting habitat selected by the prairie-chickens than the vegetation on the private ranches. Nests tended to be in areas with greater shinnery oak cover; more shinnery oak is generally available on the PCAs. Nests tended to be in areas with less basal cover by shortgrasses; the PCAs have less basal cover by shortgrasses. Nests were placed in areas where the maximum vegetation height was high; the PCAs provide greater maximum vegetation height. And although the sand sagebrush component is quite small, the prairie-chickens tended to select nest sites with more stems of the sagebrush, and the PCAs tend to have areas with more sagebrush.

Comparison of Prairie-Chicken Areas and Weaver Ranch

General Vegetation Structure

As in the comparison between the PCAs and private ranches, above, only the non-nest, that is, randomly-selected, vegetation points measured between 1 May and 30 June 2000 are included in this comparison, to make them comparable to those described in the section on nesting habitat, also above. Five vegetation points were measured on the Milnesand PCA and five on the North Bluitt PCA, for a total of ten on the PCAs. In May and June 18 points were measured on the Weaver Ranch.

Table 19. Comparison of vegetation characteristics between points on the PCAs and the Weaver Ranch. The t-test value, degrees of freedom, and probability are given only for those tests where p<0.100. Comparisons are only made on those characteristics that were significant or nearly significant in Table 9, above (analysis on nest habitat); those vegetation characteristics are probably the ones important to the prairie-chickens for nesting.

Characteristic	PCAs	Weaver Ranch	T, df, p
Canopy Cover			
Shinnery oak	4.63	2.14	**; t=2.64, df=17, p=0.009
Other	1.40	1.63	n.s.
Basal Cover			
Tallgrass	2.48	2.40	n.s.
Shortgrass	0.33	2.76	*; t=-2.39, df=17, p=0.014
Other	0.45	0.90	n.s.; t=-1.37, df=25, p=0.091
Maximum Veg. Ht.	102.58	85.73	*; t=2.36, df=25, p<0.013
Density			
Less than 10 cm	1.30	1.90	*; t=-2.10, df=21, p=0.024
No. Woody Stems			
Shinnery oak	44.36	40.65	n.s.
Sand sagebrush	0.50	1.79	n.s.
Other	1.80	1.27	n.s.

The Weaver Ranch has less shinnery oak canopy cover than do the PCAs, although it has about the same number of woody stems of the oak. The maximum vegetation height on the Weaver ranch is lower. At the near-ground level, the Weaver Ranch has much more vegetation than do the PCAs as measured by both the basal cover by shortgrasses and greater vegetation density below 10 cm.

Availability of General Prairie-Chicken Habitat

Comparison of the vegetation characteristics in Table 19 with those of the general vegetation "preferred" by the prairie-chickens in Table 13 indicates that the vegetation on the PCAs may be slightly more similar to that selected by the birds than is that on the Weaver Ranch. Shinnery oak canopy cover was "preferred" by the birds, and was greater on the PCAs. Basal shortgrass cover was "not preferred" by the birds, and was lower on the PCAs than on the Weaver Ranch. Most other characteristics that were significantly different among prairie-chicken locations (Table 13) were not significantly different between the PCAs and the Weaver Ranch.

Availability of Nesting Habitat

Comparison of the results in Table 19 with those of the nest habitat selected by the prairie-chickens (Table 9) indicates that the vegetation on the PCAs is probably more similar to the nesting habitat selected by the prairie-chickens than to the vegetation on the Weaver Ranch. Nests tended to be in areas with greater shinnery oak cover. Nests tended to be in areas with less basal cover by shortgrasses and lower vegetation density in the ground to 10 cm level, as was found on the PCAs. The prairie-chicken nests were placed in areas where the maximum vegetation height was higher than that on the Weaver Ranch. The Weaver Ranch tended to be more similar to the habitat preferred by the prairie-chickens for nesting, with regard to basal cover by tallgrasses and in having more stems of sand sagebrush and other woody species, although these differences were not significant.

CONCLUSIONS

- The maximum distance moved by the prairie-chickens was on average about 2.90 km, and the average home range size was about 6 sq. km, although one bird had a home range of over 50 sq. km. Both of these are generally larger than the smaller PCAs.
- The prairie-chicken hens generally selected areas for nesting with a greater amount of shinnery oak stems, lower grass density in the near-ground level and avoided areas with other woody plant species, than found in the general habitat.
- Although the sample size was too small for statistical analysis, successful nests generally had greater canopy cover and less basal cover.
- Nests were generally an average of 0.96 km from the lek on which the hen was trapped.
- Comparison of the general habitat available on the PCAs with that of the adjacent ranches shows that the ranches generally had less canopy cover by shinnery oak, more basal cover by shortgrasses, and a greater vegetation height. The pattern of vegetation on the PCAs is probably more similar to the nesting habitat selected by the prairie-chickens than to the vegetation on the private ranches.
- Comparison of the Weaver Ranch and PCAs shows that the ranch has less shinnery oak canopy cover than do the PCAs and the maximum vegetation height on the Weaver Ranch is lower. At the near-ground level, the Weaver Ranch has much more vegetation than do the PCAs.

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