THE EFFECTS OF LAND USE ON LESSER PRAIRIE CHICKEN POPULATIONS IN WEST TEXAS

by

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CHAPTER I

INTRODUCTION

Distribution and Status of the Lesser Prairie Chicken

The lesser prairie chicken (Tympanuchus pallidicinctus Ridgway) is a gallinaceous gamebird of North America belonging to the grouse family (Tetraonidae). Greenway (1958:190) stated that within historical times, the lesser prairie chicken has been confined to a fairly small range and there has never been a large population of these birds. However, during the Pleistocene, this species may have had a rather wide range since its bones have been found in Oregon.

Sharpe (1968) thoroughly investigated the pre-settlement and post-settlement distributions of this bird. Prior to settlement (Fig. 1), the lesser prairie chicken inhabited eastern New Mexico, the western part of Oklahoma, a large portion of western Texas, southwestern Kansas and southeastern Colorado. It is possible that this species also inhabited northeastern Colorado and southwestern Nebraska in pre-settlement times. According to the Check-list of North American Birds (1957:137), the lesser prairie chicken was formerly migratory and has been recorded as far east as southeastern Kansas and southern Missouri and wintered in southeastern New Mexico and central Texas. Bailey (1928:207-209) stated that in the mid-nineteenth century, these birds were quite numerous in the southeastern corner of New Mexico, but even at that time, the population fluctuated.

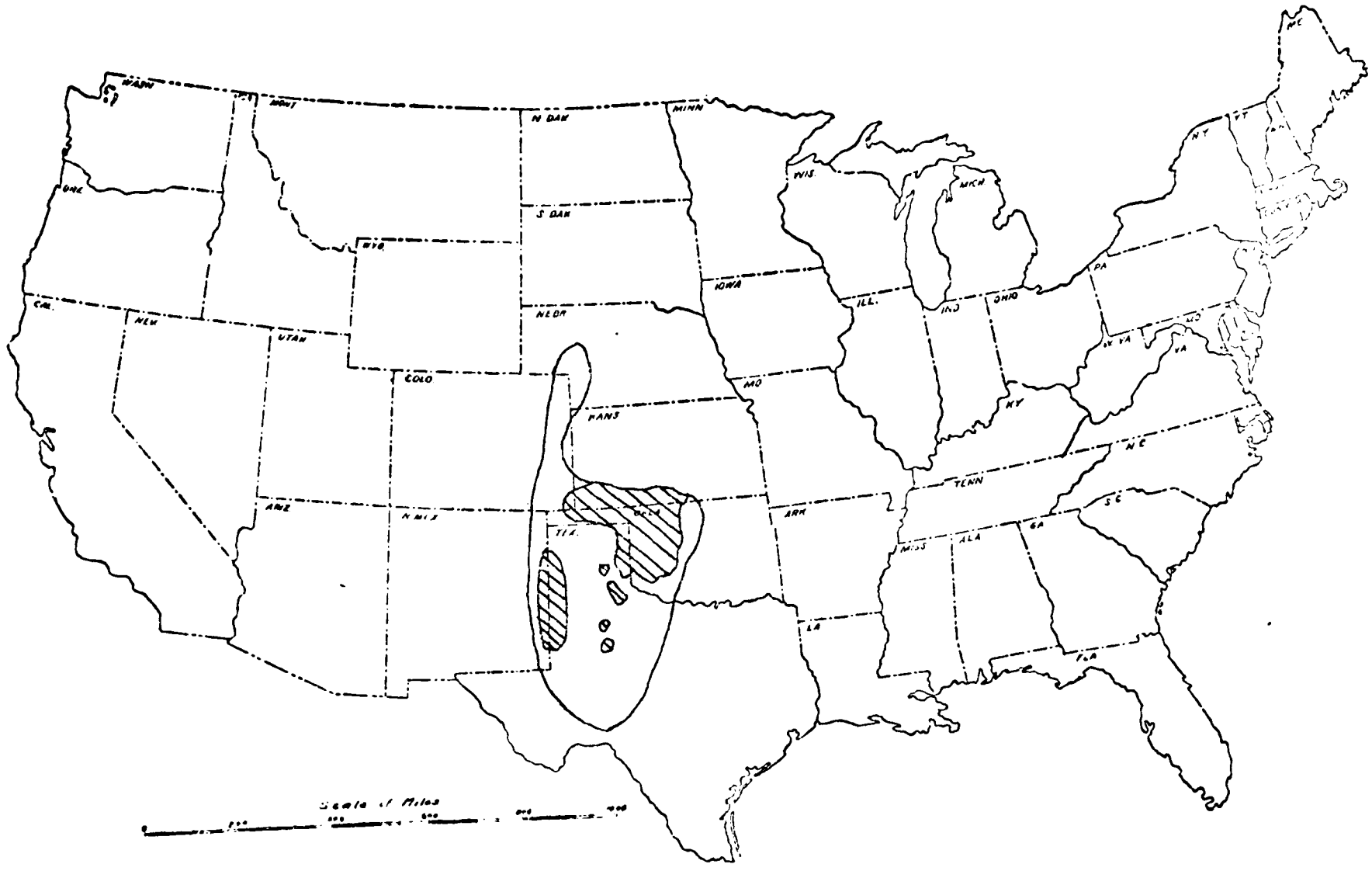

Fig. 1. Former (solid line) and current (shaded) distributions of the lesser prairie chicken (Aldrich 1963 and Sharpe 1968).

Sharpe (1968) stated that the patchwork type of farming practiced during the latter part of the nineteenth century provided a beneficial source of fall and winter food for the lesser prairie chicken. During this time, the numbers of birds increased. Despite this increase, the geographical range changed very little. Jackson and DeArment (1963) stated that the greatest abundance of this species in Texas occurred about 1900. Bent (1932) noted several accounts of great abundance of these birds during the early twentieth century. Unfortunately, this increase was rather shortlived. As early as 1904, the lesser prairie chicken was becoming more scarce each year in parts of its range (Reed 1904:143). Bent (1932) blamed overgrazing and extensive cultivation for the reduction in numbers and range of this bird. Lee (1950) stated that besides overgrazing, the droughts of the 1930's had a very serious effect upon this species. Davison (1940) found that during this period of drought, birds collected at various intervals were in good condition despite limited availability of winter food. He feels that hunting had a detrimental effect on populations during this period. Until 1935, Texas still had a four day hunting season on the lesser prairie chicken (Texas Game Fish and Oyster Commission 1935). However, by 1937 all prairie chickens in Texas were protected (Texas Game, Fish and Oyster Commission 1937). Despite protection from hunting, gobbling grounds counts dropped 50 percent from 1942 to 1953, probably as a result of the drought of the early 1950's. According to the 1968 edition of the Rare and Endangered Fish and Wildlife of the United States (U.S. Fish and Wildl. Serv. 1968), this species nearly reached extinction during the 1930's.

Currently, the lesser prairie chicken is considered a rare and vanishing species (Greenway 1958:190, U.S. Fish and Wildl. Serv. 1968). According to the United States Fish and Wildlife Service (1968), the New Mexico population flucuates from 10,000 to 50,000 birds. The Oklahoma population varies from 2,000 to 30,000 individuals. Richard DeArment (personal communication) states that the Texas population is currently declining from a high of 10,000 birds reached in the late 1960's.

The current distribution of this species is also shown in figure 1. Figure 2 shows the former and current distributions of the lesser prairie chicken in Texas. It is of interest to note that this species has been successfully introduced to the island of Niihau in Hawaii (Ralph Saito, personal communication).

Because of the rare status of this bird, several management programs have been initiated. From 1938 to 1951, the state of New Mexico bought or leased 23,644 acres for lesser prairie chicken management (Hamerstrom and Hamerstrom 1961). Colorado has restricted grazing on the National Grasslands to increase numbers of this species. The Colorado Game, Fish and Parks Commission is releasing birds obtained from Kansas. Furthermore, the United States Forest Service administers 107,000 acres in Morton County, Kansas, which could be used in management of the lesser prairie chicken. Research has been conducted in a number of areas still harboring populations of this species, but information is by no means abundant.

Lesser Prairie Chicken and Land Use

The lesser prairie chicken depends on medium and tall grasses in a region of low rainfall (Hamerstrom and Hamerstrom 1961). This dependence has been shown by serious reductions in numbers during years of drought and in areas which are overgrazed. However, this bird also relies on shrubs such as shinnery oak (Quercus Havardii) and sand sagebrush (Artemisia filifolia) for resting and escape. One of the major factors affecting lesser prairie chicken populations is the removal of these shrubs by the use of herbicides (Jackson and DeArment 1963). These authors note that treatment of one of their study areas with 2,4-D (2,4-dichlorophenoxyacetic acid) for brush control ruined the habitat for that season and only as brush began to reinvade the area did any birds return. On another study area, 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) was applied to eliminate brush and weeds. These authors believe that this treatment prevented acorn production for two years and, the loss of this key winter food supply resulted in a decline in lesser prairie chicken numbers. Furthermore, Jackson and DeArment contend that brush removal concurrent with, or followed by, overgrazing can result in habitat changes to which the lesser prairie chicken cannot adjust.

In contradiction to the above study, Donaldson (1969) found a favorable response from this species to brush control in Oklahoma. Shinnery oak areas were treated with 0.5 lbs per acre of 2,4,5-T and sand sagebrush areas received treatments of 0.5 lbs per acre of 2,4-D. All areas were sprayed at least twice; a satisfactory kill was achieved. By comparing treated and untreated areas, Donaldson

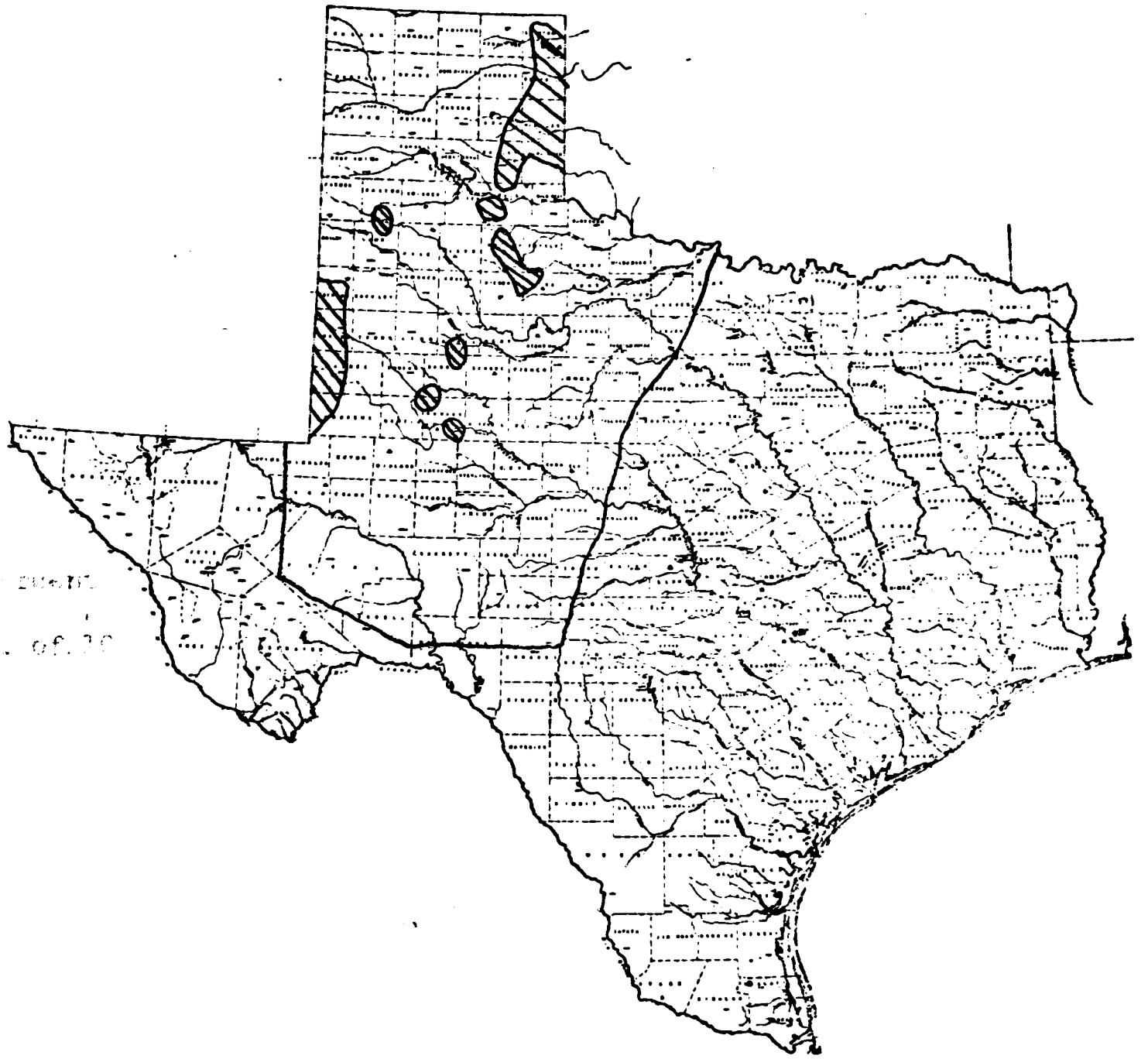

Fig. 2. Former (solid line) and current (shaded) distributions of the lesser prairie chicken in Texas (Jackson and DeArment 1963).

concluded that lesser prairie chickens will select brush controlled areas to carry on most of their life activities. This conclusion was based on the preponderance of display grounds as well as the relatively large number of birds using treated areas.

The apparent conflict of results in previous research dealing with the effects of chemically controlling brush and the paucity of information on brush control in relation to other aspects of land use indicate a need to investigate brush control in the perspective of habitat and land use.

Both Davison (1940) and Lee (1950) conducted research on lesser prairie chicken populations. Copelin (1963) divided lesser prairie chicken habitat into two classes. Class I contained 80 to 100 percent grassland and 0 to 20 percent cultivation. Class II was made up of 10 to 80 percent grassland and 20 to 90 percent cultivation.

As previously stated, patchwork farming seemed to have a positive effect upon lesser prairie chicken numbers, whereas extensive cultivation had a negative effect. Lacking, however, is definitive information on the effects of the particular type and extensiveness of cultivation. The optimum and maximum amounts of cultivation which will support lesser prairie chicken populations is unknown. Virtually no information exists in regard to areas in which both farming and ranching practices coexist. Furthermore, no research has been conducted on lesser prairie chicken populations in regard to the total effects of major land-use practices.

Purpose

The purpose of the study is to determine the effects of current agricultural practices on lesser prairie chicken populations in West Texas. An understanding of the effects of varying amounts and methods of cultivation, brush control by spraying and plowing, and grazing factors is necessary to foster the perpetuation and expansion of the lesser prairie chicken population as a wildlife resource in Texas. This understanding will lead to practical management procedures which may be adopted by individual ranchers and farmers.

CHAPTER II

METHODS

General Description of Study Areas

Because of the presence of a relatively large lesser prairie chicken population, Yoakum County was selected as the site of this study (Fig. 3). Yoakum County is in the extreme southern part of the High Plains (Llano Estacado). Portions of some study areas extended into Cochran and Terry Counties in Texas and Lea County, New Mexico. This area is considered semi-arid with an average annual precipitation of 15.6 inches (U.S. Dept. Agr. records). Most of the land consists of sandy or sandy loam soils. Nearly 60 percent of the 531,200 acres in Yoakum County is under cultivation. Grain sorghum is the most common cultivated crop. Cotton and alfalfa are also grown in this area. The remainder of the land is used primarily for cattle grazing. Petroleum exploration is also an important type of land use in Yoakum County.

Specific Study Areas

Study areas were located during March, 1972 by searching areas where lesser prairie chickens had been reported to occur. Approximately 100 miles were travelled in the 15 days spent looking for study areas. Each morning from dawn until four hours after sunrise and in the evening from four hours before sunset to dusk, the area was

traversed and stops were made every one-half mile to listen for vocalizations which would indicate a lek (communal display ground). Approximately 200 potential study sites were checked. When gobbling was heard, an attempt was made to locate the lek. Occasionally the source of vocalizations was not found since gobbling can be heard up to two miles from a lek and the vocalization has a somewhat ventriloquistic quality. After a lek was located, the percentages of rangeland and cultivation for the section of land containing the lek and the eight surrounding sections were determined. Study areas of nine sections square were recommended by Robert Jones (personal communication) because most of the essential life activities (e.g. mating and nesting) take place within one-half mile of the lek.

Of the 10 leks located, seven were selected as major study areas. Additionally, a nine section area consisting entirely of cultivated land was chosen as a major study area. The three remaining leks were selected as secondary study areas because these areas were not consistently used by cocks during the spring of 1972. From observation, it was obvious that these three areas had received recent disturbance such as plowing or road construction through the lek. The location of former leks was discussed with area residents, and from this information another secondary study area was established. This area once supported a lesser prairie chicken lek; but after an elevated road was constructed through the lek, this site was apparently abandoned. The purpose of the eight major study areas was to determine the effects of land use on lesser prairie chicken populations. The four secondary study areas were established only to

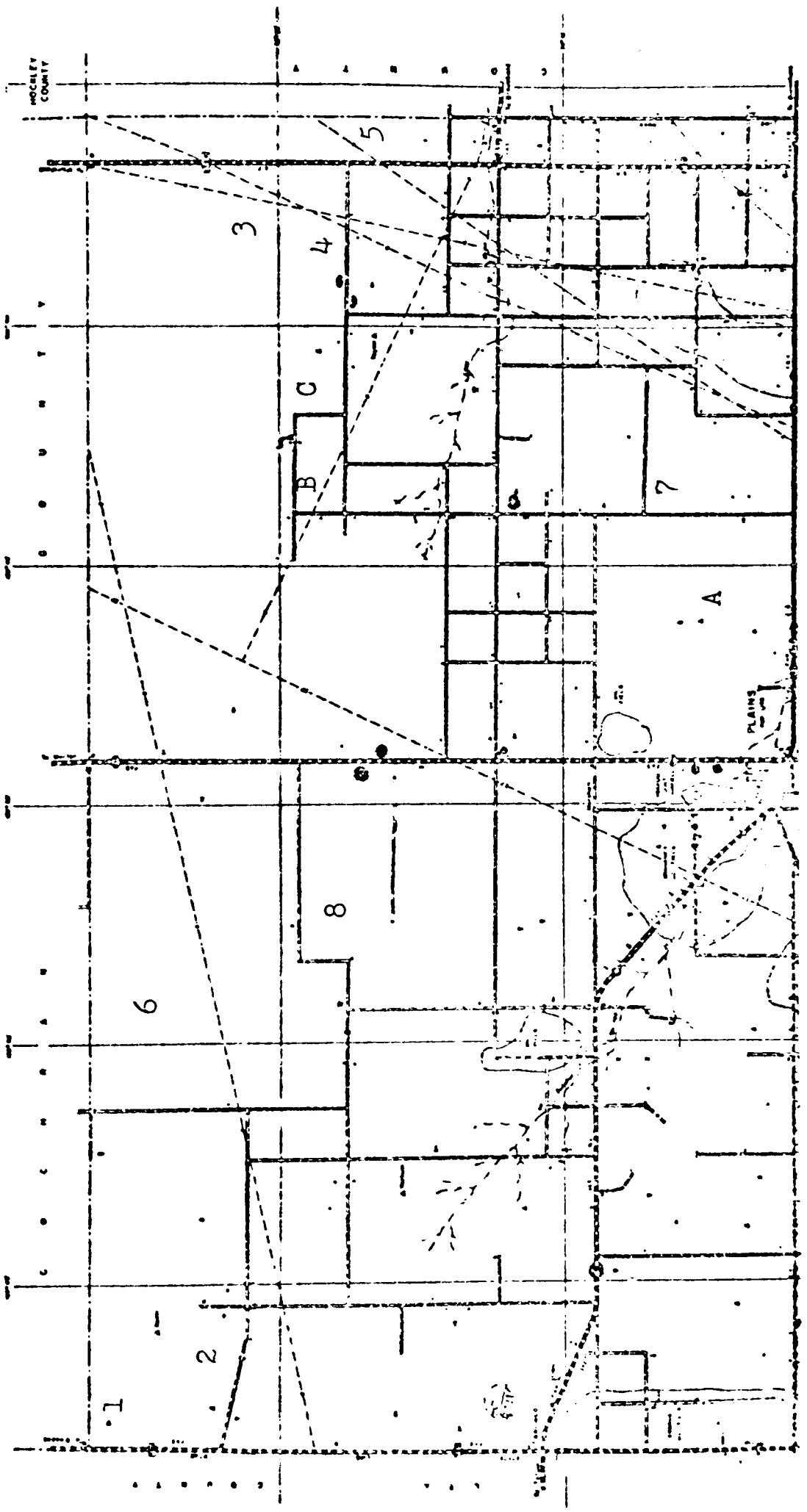

Fig. 3. Location of West Texas lesser prairie chicken study areas. Numbers show location of the lek on major study areas. Letters represent secondary study leks.

gain information on what effect disturbance of the lek had on birds occupying that lek.

Census Technique

Hoffman (1963) found that the number of males on a lek and the number of leks in an area reflected the size of the total lesser prairie chicken population on that area. Thus, a lek census was used to determine relative population size of each study area. To determine lek density, the distance from each major study area lek to the next nearest lek was measured. On major study areas, each lek was sampled three times from the last week of March until the third week of May in the spring of 1972 and 1973. Two fall counts were made in 1972 and 1973 between the third week of September and the second week of October. Three spring counts were made during each year of the study on secondary study areas. A randomized block design with sample dates as blocks and an analysis of variance test were used to determine if significant differences existed among study areas.

Duncan's New Multiple Range Test (LeClerg 1957) was used to identify significant differences between specific study areas. To adjust population figures for parametric analysis, all data were transformed using the equation, $N = \sqrt{x} + \sqrt{x + 1}$ (Snedecor and Cochran 1971:325-327). Friedman's Chi Square R Test (Woolf 1968: 314-315) was used to compare spring and fall populations for the two years of the study.

From March to May of 1972, an experiment was conducted to determine if differences existed between morning and evening lek counts and at what hours maximum numbers of cocks were on the lek.

From one-half hour before sunrise to three hours afterwards, counts were made every 15 minutes on five study areas. Cocks were also counted every 15 minutes from three hours before sunset until 30 minutes after sunset. Three replications were made for each study area. These data were transformed, as above, and analyzed with the Student's t-test (Snedcor and Cochran 1971:120-122).

During spring counts, the number of cocks on the lek was recorded. Approximately 20 minutes were spent counting birds on each study area. In the fall, the total number of birds on the lek was noted. However, this number could not be broken down into sex groups because many birds would remain in cover and could not be seen until flushed. Also, juvenile birds were present near the lek in fall and were impossible to sex by observation.

Land Use

Information regarding specific types of land use for each study area was obtained from the Soil Conservation Service in Plains, Texas. Data on soils, range condition, grazing intensity, amount and types of brush control and amount and types of cultivation were determined for major study areas during the summer of 1972.

The percentage of each range site (i.e. Deep Sand, Sandy Land and Sandy Loam) on the major study areas was obtained from soils maps (Dittemore and Hyde 1960). Range site descriptions follow those in use by the Soil Conservation Service (Dittemore and Hyde 1960).

The percentage of each of the four range condition classes shown in table 1 was determined for each major study area. Each condition class was assigned a point value. These values are as

follows: Poor, one point; Fair, two points; Good, three points; and Excellent, four points. Each range condition class value was multiplied by the percentage that class made up of the total for each study area. These four values were then added to obtain the average range condition of the rangeland component of each study area.

From Soil Conservation Service records, the amount of ungrazed, lightly, moderately and heavily grazed rangelands was determined. The description of each grazing class is shown in table 2. To obtain the overall grazing intensity for each area, the following point values were assigned to each grazing class: Heavy Grazing, one point; Moderate Grazing, two points; Light Grazing, three points; and Ungrazed, four points. The value of each grazing class was multiplied by the percentage of that class on each study area. These four values were added together to obtain the average grazing intensity.

The amount of chemical brush control on each study area was obtained by interviewing landowners and from Soil Conservation Service records. The percentage of each study area which received brush control, year and number of applications were recorded. Chemical brush control consisted of an aerial spray of 0.5 lbs per acre of 2,4,5-T. Areas once plowed for cultivation, but subsequently abandoned and reverted to rangeland were also treated as brush controlled lands. The percentage of plowed land and year of abandonment were recorded for each study area.

From Soil Conservation Service records and field observation during 1972, the amount of cultivation, if any, was determined. The

percentage of grain sorghum and the amount of land farmed by the use of minimum tillage techniques were recorded. Minimum tillage farming involves leaving the stubble in the field after harvesting until the land is prepared for planting in the spring (C. M. Thompson, personal communication). Special minimum tillage equipment is used and traditional plowing is eliminated.

Table 1. Description of range condition classes. [a]

Range Condition Class	% Desirable Plants Remaining
Excellent	76 to 100
Good	51 to 75
Fair	26 to 50
Poor	0 to 25

[a] Dittemore and Hyde (1960).

Table 2. Description of grazing intensity classes. [a]

Grazing Intensity Class	% Current Season's Growth Removed
Ungrazed	Ungrazed
Light Grazing	< 25
Moderate Grazing	25 to 50
Heavy Grazing	> 50

[a] Soil Conservation Service, Plains, Texas.

Vegetation Analysis

The rangeland component of all major study areas was categorized into range-use types. Areas consisting of the same range site, condition, grazing intensity and type of brush control were considered to be one range-use type. Using the combinations of these factors, 23 distinct range-use types were found on the seven study areas containing rangeland.

DuRietz' life-form classification as used by Jones (1963), shown in table 3, was used to categorize shrubs, forbs and grasses. Ten 100 feet random line transects were used to determine crown cover of shrubs and forbs. Along each transect, five 4.8-feet^2 quadrats were laid out to estimate basal cover of grasses. Preliminary vegetation sampling was conducted during the summer of 1972 to determine the number of samples required. The formula, $n = \frac{t^2 \ s^2}{+ .20 \ \bar{x}}$ (t = t value, s^2 = variance, $\bar{x}$ = sample mean), was used at $p < .10$ and within 20 percent of the sample mean (Snedecor and Cochran 1971:516-518). These results dictated vegetational sampling in the summer of 1973.

The average amount of cover for each life-form on a specific range-use type was multiplied by the percentage of that type on each major study area. Thus, the average percentages of cover of the various life-forms for each study area was obtained. Figures were also combined to form the major groups of total shrub cover, total forb cover and total grass cover. The plant species most commonly found in quadrats and along transect lines were noted according to range site to aid in the description of study areas.

Table 3. Life-form classification system. [a]

Type of Plant	Description
Herbaceous Plants	
Grasses	
(S.G.) Short grass	< 25 cm
(M.G.) Mid-grass	25 cm - 80 cm
(T.G.) Tall grass	> 80 cm
Forbs	
(S.F.) Short forb	< 25 cm
(M.F.) Mid-forb	25 cm - 80 cm
(T.F.) Tall forb	> 80 cm
Woody Plants	
(T) Tree	Distinct main trunk remaining unbranched in its lower parts.
(S) Shrub	Stem branched from its basal parts. Above or below the ground. > 80 cm.
(D.S.) Dwarf shrub	Conforming to shrub description but < 80 cm.
(H.S.) Half-shrub	Only the lower parts of the stem lignified and perennial; the upper parts are annual and herbaceous. > 80 cm.
(D.H.S.) Dwarf half-shrub	Conforming to half-shrub description but < 80 cm.

[a] Jones (1963) after DuRietz (1931).

The land-use and vegetation factors were compared to lek size of the major study areas for the spring and fall of 1972 and 1973 by the use of multiple regression techniques (Snedecor and Cochran 1971:381-418). Two multiple regression analyses were necessary for each sampling period because certain land-use and vegetation factors did not apply to all study areas. One area contained no rangeland and, thus, measurements pertaining to rangeland were not applicable. Two others contained no cultivation. Therefore, one analysis dealt with cultivation factors on all areas having cultivation and the other analysis dealt with rangeland factors on all areas containing rangeland.

Preliminary Vegetational Sampling

Preliminary vegetational sampling indicated ten 100 feet transects, used to determine crown cover of shrub and forb life-forms in each range-use type, satisfied 68 percent of the required samples. Fifty 4.8-feet^2 quadrats, used to find basal cover of grass life-forms, satisfied 73 percent of the necessary samples. By doubling the number of samples taken, less than three percent would be gained in satisfying the number of required samples. Thus, ten 100 feet line transects for each range-use type were used to estimate cover of the life-forms of shrubs and forbs and fifty 4.8-feet^2 quadrats were used to determine cover of grass life-forms.

Diet and Water Requirements

Jones (1964a) and Copelin (1963) each noted late summer and fall usage of earthern stock ponds for drinking water by lesser prairie chickens. However, no information existed regarding spring water requirements. Thus, an experiment was designed and conducted in the spring of 1972 to investigate these needs; the methods used in this study were reported by Crawford and Bolen (1973).

A number of authors have discussed the diet and feeding behavior of the lesser prairie chicken. Bent (1932), Sutton (1967:135-137) and Jones (1964b) noted the importance of grain sorghum, grasshoppers and beetles among many food items in the diet of this species. Copelin (1963) found birds feeding in cultivated fields when rangeland failed to produce adequate acorns and forb and grass seeds. Sharpe (1968) stated that birds formerly left breeding grounds in search of winter food. These movements may have accounted for sightings of birds in southern New Mexico, central Texas, southwestern Missouri and eastern Kansas. However, no information has been published regarding the diet of the lesser prairie chicken in West Texas. Thus, an autumnal dietary study was undertaken. Thirty crops were randomly selected from birds brought through the Lehman Check Station during the mid-October hunting season each year from 1971 to 1973. These 90 crops represented 10 percent of the legal harvest in West Texas for the three year period. Additionally, one crop was obtained from a bird found dead on March 27, 1973. The crops were placed in tin foil containers and oven dried at 77 C for 72 hours.

The contents of each crop were separated, identified and weighed. Volume was obtained by sand displacement. A key to the identification of insects by Borror and DeLong (1964) was used to identify and classify insect material. Correll and Johnston (1970) was used to identify and name plants in the diet of the lesser prairie chicken. Monthly observations were made of two minimum tillage areas from March 1973 to February 1974 to determine if field feeding birds were present.

CHAPTER III

RESULTS

Preliminary Bird Census

The results of the experiment conducted to determine the optimum sampling time for lek counts are shown in table 4. The range for A.M. counts was from sunrise until 105 minutes after dawn. An average of those times when the maximum number of males was present for more than one sample time was taken. All A.M. data were averaged to find that maximum counts were obtained at an average of 27 minutes after sunrise. Maximum P.M. counts ranged from 135 minutes before sunset to 30 minutes afterwards. Averaging times when maximum numbers were present for more than one sample period and taking the average of all observations indicated maximum counts were obtained, on the average, 49 minutes before sunset. No birds were present during the last P.M. count of study area 7.

A comparison of A.M. and P.M. counts is shown in table 5. The A.M. counts are significantly higher than P.M. counts ($P < 0.05$). Utilizing the results of these experiments, all lek census figures were subsequently obtained in the morning between sunrise and 60 minutes after dawn for the remainder of the study.

Table 4. Time of day when maximum number of cocks were present on leks of five study areas in West Texas, spring, 1972. [a]

Date (1972)	Study Area	Time, in Minutes, When Maximum Number of Cocks Were Observed	
		A.M.	P.M.
4-6	4	+45	Sunset
4-7	3	+30	-15
4-8	6	+60	-15
4-13	7	Sunrise to +105	-15
4-14	1	Sunrise to +60	+30
4-19	4	Sunrise	-120
4-20	3	+30	-30 to -15
4-27	6	Sunrise	-45
5-10	7	Sunrise	-90
5-11	1	+15	-90
5-12	4	+60 to +75	-45 to -30
5-15	3	Sunrise to +75	-60 to -30
5-17	6	+15 to +45	-120 to -60
5-19	7	Sunrise	No Count
5-20	1	Sunrise	-135

[a] (For A.M. counts, - indicates before sunrise; + means after sunrise. For P.M. counts, + signifies before sunset; - refers to after sunset.)

Table 5. Comparison of A.M. and P.M. lek counts of the lesser prairie chicken on five study areas in West Texas, spring, 1972.

Study Area	Sample	A.M. Count	P.M. Count
1	1	10	8
	2	9	7
	3	9	9
3	1	23	16
	2	19	5
	3	18	18
4	1	25	21
	2	22	19
	3	23	23
6	1	20	19
	2	16	16
	3	16	15
7	1	12	6
	2	8	9
	3	2	0

Description of Major Study Areas

The eight major study areas contained from 100 to 0 percent rangeland. Two study areas were 100 percent rangeland. Four areas contained limited cultivation (5 to 37 percent). Another area (7) was composed of a single section of rangeland surrounded by cultivation. Three sections of land adjoining this study area were plowed the year prior to the initiation of this study. Another area consisted of 100 percent cultivation. A complete description of the habitat and land-use factors for each major study area is given in table 6. Chemical brush control listed in the table consisted of 2,4,5-T applied at the rate of 0.5 lbs per acre. All areas which had been

Table 6. Description of habitat and land use factors on major West Texas lesser prairie chicken study areas, summer, 1973.

Parameters	Study Area 1	2	3	4	5	6	7	8
% Deep Sand	74	56	94	61	97	36	8	2
% Sandy Land	6	44	6	36	3	50	86	86
% Sandy Loam	20	0	0	3	0	14	6	12
% Rangeland	100	100	95	87	70	63	11	0
Avg. Range Condition [a]	2.7	2.4	2.4	2.7	1.4	2.2	3.0	-
Avg. Grazing Intensity [b]	2.0	1.8	1.2	1.7	3.8	1.5	3.0	-
% Sprayed Twice 1959-63	92	90	6	0	0	0	0	-
% Sprayed Once 1968	0	0	0	0	0	24	0	-
Total % Plowed	0	0	12	0	67	0	0	-
% Dwarf Half Shrubs	2	3	0	0	0	1	3	-
% Dwarf Shrubs	25	21	41	33	18	27	29	-
% Shrubs	0	0	0	1	0	0	3	-
% Shrub Cover	27	23	41	33	18	29	33	-
% Short Forbs	1	3	2	3	4	8	2	-
% Mid Forbs	0	1	1	1	2	1	2	-
% Total Forb Cover	2	3	3	4	6	9	4	-
% Short Grass	19	24	10	23	4	29	14	-
% Mid Grass	8	5	4	3	6	2	9	-
% Tall Grass	0	0	0	0	1	0	0	-
% Total Grass Cover	28	29	15	26	12	32	23	-
% Cultivation	0	0	5	13	30	37	89	100
% Minimum Tillage of Grain Sorghum	-	-	0	60	36	40	8	0

[a] Range condition classes were assigned the following values: Excellent = 4, Good = 3, Fair = 2, Poor = 1. To obtain average range condition, the percent of each condition for every study was multiplied by the value of the condition class and the resulting values were summed.

[b] Levels of grazing intensity were assigned the following values: Ungrazed = 4, Light = 3, Moderate = 2, Heavy = 1. Average grazing intensity was obtained by multiplying the percent of each grazing level for every study by the assigned value for that level and the resulting values were summed.

plowed, cultivated and abandoned, were reverted to rangeland between 1966 and 1968. In deep sand areas of lesser prairie chicken habitat, shin oak was the most common shrub. Sand dropseed (Sporobolus cryptandrus), purple threeawn (Aristida purpurea), sand bluestem (Andropogon Hallii) and little bluestem (Schizachyrium scoparium) were common grasses. In sandy land areas, blue grama (Bouteloua gracilis) and buffalo grass (Buchloe dactyloides), interspersed with mesquite (Prosopis glandulosa) and catclaw mimosa (Mimosa biuncifera), were the most common plants. The plants most commonly found during the vegetation analysis according to life-form and range site are given in table 7. Scientific names of these plants are listed in appendix C.

Lek Census Results

The average number of cocks on each study lek during the two years of the study and the average number of birds on the lek each fall are given in table 8. Analysis of variance tests indicated significant differences among study areas for each sample period (Spring 1972, F = 48.72; Fall 1972, F = 21.29; Spring 1973, F = 47.00; Fall 1973, F = 9.92). No significant difference was found between blocks (i.e. sample dates) for any sampling period. The results of the Duncan's New Multiple Range Tests are given in table 9.

The average distance between leks on areas having limited cultivation was 1.5 miles (Table 10). Areas of 100 percent rangeland averaged 2.0 miles between leks. Where extensive cultivation occurred, the average distance between leks was 3.1 miles.

Table 7. Most common plants of major West Texas lesser prairie chicken study areas according to life-form and range site, summer, 1973.

Range Site	Life-form			
	Dwarf Half-Shrub	Dwarf Shrub	Shrub	Short Forb
Deep Sand	Broom Snakeweed	Shin Oak Sand Sagebrush Yucca	Shin Oak	Dalea Camphorweed Sensitive Briar
Sandy Land	Broom Snakeweed	Mesquite Catclaw Mimosa Sand Sagebrush Shin Oak Yucca	Mesquite	Plantain Spiny Haplopappus Nama Sleepy-Daisy Pepperweed Zinnia Monarda
Sandy Loam	Broom Snakeweed	Mesquite Yucca	Mesquite	Sleepy Daisy Pepperweed Zinnia Monarda

Table 7. Continued.

Table 7. Continued.

Range Site	Life-form: Mid Forb	Short Grass	Mid Grass	Tall Grass
Deep Sand	Threadleaf Groundsel Evening Primrose Spectacle-pod Cryptantha	Sand Dropseed Purple Threeawn Grassbur Hooded Windmill Grass	Little Bluestem	Sand Bluestem
Sandy Land	Threadleaf Groundsel Yellow Woolywhite	Buffalo Grass Blue Grama Purple Threeawn Wright's Threeawn Grassbur	Little Bluestem	None
Sandy Loam	Threadleaf Groundsel Yellow Woolywhite	Purple Threeawn Blue Grama	Needle and Thread Grass	None

Table 8. Average number of lesser prairie chickens on leks of major West Texas study areas, 1972-73. [a]

Study Area	1972 Spring	1972 Fall	1973 Spring	1973 Fall
1	9.3	5.0	14.3	78.0
2	11.0	4.5	13.0	15.0
3	20.0	28.5	24.7	17.0
4	23.3	38.0	24.3	37.0
5	25.7	38.0	31.3	28.0
6	17.3	48.0	25.3	53.0
7	7.3	15.5	3.3	2.0
8	0.0	0.0	0.0	0.0

[a] Spring counts represent the number of cocks; fall counts include hens and cocks.

Two Friedman's Chi Square R Tests were used to determine if significant differences existed between population size in 1972 and 1973. One test compared spring 1972 to spring 1973 and the other contrasted fall 1972 to fall 1973. The average spring lek size, on those areas having active leks, was 14.0 cocks in 1972 and 17.0 cocks in 1973. This 22 percent increase was significant at the 90 percent confidence level. No birds were present during any sample on study area 8. Study area 7 demonstrated a 55 percent decrease in population size from spring 1972 to spring 1973. All other study areas increased in size or were stable during the same period.

The average fall lek size, on areas with active leks, was 22.2 birds in 1972 and 28.8 birds in 1973. Although there was an average population increase of 30 percent from one fall to the other, this difference was not significant ($p < 1.00$). Study areas 1, 2 and 6 increased in size from fall 1972 to fall 1973. Other areas decreased

Table 9. Results of Duncan's New Multiple Range Tests showing significant differences and similarities among lek populations on major study areas in West Texas, 1972-73. [a]

Sampling Period	Study Areas							
Spring 1972	8 [b]	7	1	2	6	3	4	5
Fall 1972	8	2	1	7	3	4	5	6
Spring 1973	8	7	2	1	4	3	6	5
Fall 1973	8	7	2	3	5	4	6	1

[a] Lines under study areas indicate those which are not statistically different from one another at the 95 percent confidence level.

[b] This table lists the study area with the least number of birds on the left hand side and progresses, in order, to the largest number.

in size or were stable. It was noted that the average number of birds on leks increased 50 percent from spring 1972 to fall 1972 and 66 percent from spring to fall of 1973. These figures may indicate the relative reproductive success for the two years of the study. Those areas possessing limited cultivation averaged 24.0 males in spring and 35.9 birds in the fall. Areas of 100 percent rangeland averaged 11.9 males and 25.7 birds for spring and fall respectively. Where extensive cultivation occurred, there was an average of 2.7 males in spring and 4.4 birds in the fall.

Table 10. Lesser prairie chicken lek density as determined by the next closest lek to each major study area, 1972-73.

Study Area	Next Closest Lek (Miles)
1	2.0
2	2.0
3	1.5
4	1.5
5	1.0
6	1.8
7	2.7
8	3.4

Land-Use and Habitat Factors

The land-use and habitat factors listed in table 6 were compared to lesser prairie chicken populations for each sampling period by the use of multiple regression techniques. For each sampling period, two regressions were made. Regression A includes soil and cultivation factors but excludes range and vegetation data. Regression B excludes cultivation factors. The results of these regression analyses are shown in table 11. These results demonstrate the importance of the amount of rangeland in maintaining high lesser prairie chicken populations. Where cultivation exists, minimum tillage was found to be influential on populations. Also, populations are correlated with the amount of deep sand. The above factors appear to be of greatest importance because of their recurrance in each sampling period. Shown in table 12 are the simple correlations between those factors found to be important by the multiple regression analyses and lesser prairie chicken populations.

Secondary Study Areas with Lek Disturbance

During the initiation of the study, three areas were found where there had been some physical disturbance of the lek. Study lek A was located on one section of cultivated land surrounded by rangeland. The lek section was broken for cultivation in 1963. According to numerous reports from area residents, this lek remained active through 1970. In 1971, four sections of rangeland adjoining the lek section were broken for cultivation. In 1972, three males were observed on this lek in April. However, no birds were present in

Table 11. Results of multiple regression analyses of habitat and land-use factors in relation to lesser prairie chicken lek populations, 1972-73. [a]

Analysis	Variable	R^2	Analysis	Variable	R^2
	Spring 1972			Fall 1972	
A	X_4 % Rangeland	.8196	A	X_4 % Rangeland	.6341
	X_{22} % Minimum Tillage	.8657		X_{22} % Minimum Tillage	.7531
	X_1 % Deep Sand	.8979		X_3 % Sandy Loam	.7552
	X_2 % Sandy Land	.9031		$Y_{2A} = 3.58019 + .04658X_3$	
	$Y_{1A} = -4.11427 + .09669X_1 + .07491X_2$			$+ .07558X_4 + .07257X_{22}$	
	$+ .03857X_4 + .04858X_{22}$				
B	X_{10} % Dwarf Half-Shrubs	.8752	B	X_7 % Sprayed Twice	.7744
	X_{13} % Total Shrub Cover	.9308		X_{12} % Shrub Cover	.9348
	X_3 % Sandy Loam	.9677		X_{20} % Total Grass Cover	.9778
	X_{17} % Short Grass	.9996		X_{19} % Tall Grass Cover	.9912
	X_5 Average Range Condition	1.0000		X_1 % Deep Sand	.9999
	$Y_{1B} = 11.27478 - .06392X_3 - .17367X_5$			$Y_{2B} = 3.11518 + .03821X_1 - .10377X_7$	
	$- 1.28334X_{10} - .05635X_{13} + .04543X_{17}$			$- .72890X_{12} + 2.04419X_{19} + .29453X_{20}$	

Table 11. Continued.

Table 11. Continued.

Analysis	Variable	R^2	Analysis	Variable	R^2
	Spring 1973			Fall 1973	
A	X_4 % Rangeland	.8665	A	X_4 % Rangeland	.6428
	X_{22} % Minimum Tillage	.9001		X_3 % Sandy Loam	.8316
	X_2 % Sandy Land	.9381		X_{22} % Minimum Tillage	.9193
	X_1 % Deep Sand	.9543		X_1 % Deep Sand	.9518
	$Y_{3A} = 20.70171 - .13674X_1 - .21107X_2 + .03676X_4 + .04729X_{22}$			$Y_{4A} = - 4.14911 + .07105X_1 + .55191X_3 + .06278X_4 + .08846X_{22}$	
B	X_{10} % Dwarf Half-Shrub Cover	.7353	B	X_{15} % Mid Forb Cover	.5479
	X_{12} % Shrub Cover	.9534		X_{19} % Tall Grass Cover	.7949
	X_{14} % Short Forb Cover	.9791		X_{16} % Total Forb Cover	.9575
	X_8 % Sprayed Once	.9946		X_5 Average Range Condition	.9949
	X_7 % Sprayed Twice	1.0000		X_{18} % Mid Grass Cover	.9997
	$Y_{3B} = 8.48722 + .01790X_7 - .09759X_8 - 1.56888X_{10} - .59556X_{12} + .70297X_{14}$			$Y_{4B} = - .34062 + 6.47894X_5 - 9.59989X_{15} + 1.19383X_{16} - .23156X_{18} + 15.29626X_{19}$	

[a] Regression analysis A for each sample period excluded rangeland factors for those areas where they are not applicable. Analysis B excludes cultivation factors where they do not apply.

Table 12. Simple correlation coefficients between regression factors in table 11 and lesser prairie chicken populations.

Factor	Sampling Period			
	Spring 1972	Fall 1972	Spring 1973	Fall 1973
% Rangeland	.905	.795	.928	.801
% Minimum Tillage	.647	.703	.633	.771
% Deep Sand	.835	.093	.856	.592
% Sandy Loam	-.428	-.336		-.112
% Total Shrub Cover	-.062	.148	-.164	
% Dwarf Half-Shrub Cover	-.936		-.858	
% Sandy Land	-.840		-.883	
% Sprayed Twice		-.880	-.243	
Average Range Condition	-.674			-.211
% Tall Grass Cover		.336		.010
% Total Grass Cover		-.268		.349
% Mid Forb Cover				-.740
% Short Forb Cover			.445	
% Mid Grass Cover				-.296
% Sprayed Once			.266	
% Short Grass	-.241			
% Total Forb Cover				.159

March or May. Census counts in 1973, indicated one male present from March through May.

Study lek B was characterized as a traditional, large lek by a local landowner. In 1964, an elevated county road was constructed through the center of this lek. No birds were observed on this area in 1972 or 1973. To determine if the presence of a road or some other factor (e.g. disturbance by traffic or height of road surface) was responsible for the abandonment of lek B, a lek was censused that also had a road constructed through it at the same time as lek B but this non-elevated road was used infrequently. On this comparison lek, the birds were present from March to May 1973 and the lek population averaged 23.3 cocks.

Study lek C consisted of an area of 80 percent rangeland in which one-half of the lek was plowed for cultivation. This lek was also reported by residents as a traditional site. In May, 1972, three males were observed courting a hen near the former lek. No birds were observed during March or April of that year, nor at anytime during the spring of 1973.

Diet and Water Requirements

The autumnal diet of the lesser prairie chicken in West Texas was obtained by sampling crops of birds coming through the Lehman Check Station during the fall hunting season. The crops contained 23 identifiable plants which accounted for 90 percent of the food by weight and 81 percent by volume. The remainder was composed of insects from 13 families. Grain sorghum, the most common food, had a frequency of 58 percent and composed 63 percent of the diet by weight and 43 percent by volume. Other common food items were wild flax (Linum rigidum), shin oak acorns, oak galls, beetles (Tenebrionidae, Chrysomelidae, and Carabidae) and grasshoppers (Acrididae and Gryllacrididae). A summary of the fall diet is given in table 13; the complete analysis is shown in appendix A. Also, a crop was obtained from a bird found dead on March 27, 1973; the contents of this crop are listed in appendix B.

The results of the monthly observation of grain sorghum fields indicated regular use by birds from September through May. No use was observed from June through August. Birds fed in fields before and after harvesting. However, in early winter, those fields which were

plowed were no longer used and birds fed in minimum tillage areas where seeds were still available.

Table 13. Summary of fall diet of the lesser prairie chicken in West Texas, 1971-73.

Food	% Frequency	% Weight	% Volume
Cultivated Crops [a]	58.73	64.47	45.65
Grasses	12.70	0.41	0.95
Forbs	52.38	9.96	13.10
Shrubs	49.21	15.33	21.10
Insects	42.86	10.02	19.03

[a] Of the cultivated crops consumed, grain sorghum comprised 95.87% by weight and 94.23% by volume; wheat made up 2.61% by weight and 2.32% by volume; alfalfa represented 1.53% by weight and 3.45% by volume.

Observations on watering behavior during the spring of 1972 indicated birds drank from earthern stock ponds or metal water tanks buried to ground level. Weekly observations of two earthern stock ponds and one buried metal tank indicated regular use by birds during a period of spring drought. Birds were observed watering in both morning and evening. In early May, 1972, spring rains relieved the drought and no further use of man-made water impoundments was observed.

CHAPTER IV

DISCUSSION

Study Area Bird Populations

The results of population censusing indicated significant differences existed between study areas for each sampling period. The highest populations were usually found on those study areas possessing limited cultivation. One exception to this statement occurred in fall, 1973. In this instance, study area 1 supported a very high population (78 birds). The lek of study area 1 was within 300 yards of a man-made water impoundment. On all other study areas, the nearest water source was over 0.5 miles from the lek. Jones (1964a) and Copelin (1963) noted use of stock ponds for drinking in late summer and fall. Precipitation records (U.S. Dept. Comm. 1972, 1973) indicate total precipitation for September and October, 1972 amounted to 7.1 inches. For the same period in 1973, total precipitation was 1.19 inches. Because of drought conditions in fall, 1973, birds may have concentrated near water sources. Thus, the extremely high population on study area 1 in fall, 1973 may have been a result of water availability on that area.

The populations on study areas 1 and 2 were not statistically different except during the fall, 1973 sampling period. The

populations of these areas of 100 percent rangeland ranked second in numbers to those areas with limited cultivation. Study areas 5 and 6 tended to have the highest populations. Study areas 3 and 4 likewise had high populations. However, among these four areas, no trend developed as to which contained the highest population. The population on study area 7 apparently was not maintaining itself. The fall, 1972 count was approximately double the spring count for that year. However, the spring, 1973 count was about one-half of the previous spring. The fall, 1973 count was lower than the spring of that year. It appears little or no production occurred on that area in 1973. No lek activity was observed on study area 8 during any sampling period.

The results of approximating lek density by the next nearest lek to each lek studied showed that areas with limited cultivation possess the highest lek density. Areas of 100 percent rangeland ranked second and areas with extensive cultivation had the lowest lek density.

Population size and bird density data indicate maximum bird populations occur on study areas consisting of 63 to 95 percent native rangeland and the remainder in cultivation provided grain sorghum is the primary crop. Areas of 100 percent rangeland are capable of supporting a population which can maintain itself, but the numbers of birds are less than where limited cultivation exists. Birds were not usually found using areas of more than 37 percent cultivation for lek activities. Study area 7 consisted of 89 percent cultivation and apparently was not capable of sustaining a population.

For the lesser prairie chicken range in West Texas, areas of 63 to 95 percent native range are considered Class I habitat; 100 percent rangeland is Class II; areas with less than 63 percent rangeland are undesirable for use by this species. This ranking system is in contrast to that used by Copelin (1963). In that study, Class I lesser prairie chicken habitat consists of 80 to 100 percent grassland and Class II consists of 10 to 80 percent grassland. However, no population data relating to different percentages of the rangeland component were presented, and, thus no comparison can be made. It is possible that acorn and other seed production were greater on areas studied by Copelin and that the West Texas population is more dependent on cultivated crops to maintain high populations.

Diet and Water Requirements

The autumnal diet analysis tends to correspond to those given by Bent (1932), Copelin (1963), Jones (1963) and Sutton (1967:135-137). However, none of these authors reports as great a reliance on grain sorghum as did this study. Bent (1932) noted the use of cultivated crops. Copelin (1963) stated that feeding behavior was influenced by deficiencies in acorn and grass and forb seed production; he found field feeding when insufficient seed was produced on rangelands. Jones (1963) noted the use of grain sorghum where available. His studies showed the October diet to consist of 20 percent seeds, 74 percent insects and 6 percent green leafy material. Also noted was the importance of green leafy material in the diet from November through March. Sutton (1967:135-137) noted the importance of acorns and grain in the diet. Also, the fruit and buds of skunkbush sumac

(Rhus aromatica), grasshoppers, beetles and leaves of small annuals were consumed by the lesser prairie chicken. Martin, Zim and Nelson (1951:97) stated that oak accounts for 52 percent of the diet from fall through spring. Wheat comprises 5 to 10 percent of the fall and winter diet. Grain sorghum amounts to only 0.5 to 2 percent of the total diet. These authors consider grasshoppers of greatest importance in the animal portion of the diet, but, also found beetles, bugs and caterpillars consumed to a small extent.

The autumnal diet analysis of the lesser prairie chicken in West Texas indicated variety in the foods consumed. The importance of the rangeland habitat for feeding was shown by the amount of shrubs, forbs, grasses and insects eaten. However, a strong dependence on cultivated crops was demonstrated. A single crop obtained in the spring contained a considerable amount of grain sorghum and green leafy material which again indicated the importance of both rangeland and cultivated areas for feeding.

Monthly observations of feeding behavior also emphasize the importance of cultivated crops. The traditional farming method of fall plowing eliminates waste grain as a food source. However, minimum tillage techniques allow food to remain available through the critical periods of winter and early spring. Feeding in grain fields was observed as early as September and continued throughout May in minimum tillage areas. Thus, although grain sorghum cultivation provides an important source of food, it must be carried out on a limited basis so as not to destroy the essential native rangeland habitat.

This study indicated use of stock ponds for drinking water during a period of spring drought. The need for water would be reflected by the availability of water from other sources in the habitat. Diet is undoubtedly of importance in this respect. Perhaps the lesser prairie chicken does not require abundant free water in the spring since it inhabited arid regions prior to settlement and the concurrent development of water resources. However, Lee (1950) reported that populations decreased during periods of drought. The reasons for such declines are no doubt complex, but it is probable that the advent of man-made water impoundments may now enhance the survival of this species during periods of spring drought.

Land-Use Effects

The results of the analyses of land-use and habitat factors indicate the importance of land use, soils and vegetation cover in determining lesser prairie chicken populations. Copelin (1963) believes that population density was not influenced as much by vegetation type, as it was by the combined influence of soils, vegetation and land use. The results of the regression analyses support this idea and quantify important factors. These factors will be discussed according to consistency during the sample periods and the magnitude of the correlation coefficients (see Table 12).

There were only three common factors in all sampling periods. The percent rangeland, percent minimum tillage and percent deep sand were important during each period and normally possessed high simple correlation coefficients. I consider these factors of greatest importance. The positive correlations ($r = .91, .80, .93$ and $.9$

for respective sampling periods) with percent rangeland appears of prime importance. Areas of less than 63 percent can not support high, stable populations. However, areas of 100 percent rangeland do not support as many birds as those areas with limited cultivation. If the lesser prairie chicken is to thrive, relatively large tracts of native range must be maintained.

The results of the land-use analyses also indicate a positive correlation ($r = .65, .70, .63$ and $.77$ for respective sampling periods) between the amount of minimum tillage of grain sorghum on study areas having cultivation and the population size during each sampling period. The diet analysis demonstrates heavy reliance upon this grain for food, and feeding behavior observations indicate the importance of minimum tillage areas for feeding during a critical time of year.

The benefits of minimum tillage are not restricted to the lesser prairie chicken alone. The Soil Conservation Service reports that acreage suffering wind erosion damage in the Great Plains more than tripled from November and December, 1972 to the same period of 1973 (Willson, 1974). In the High Plains region of Texas the number of acres damaged increased nearly eightfold from 124,000 acres in late 1972 to 947,000 in late 1973. Wind erosion damage results from inadequate residue cover, insufficient moisture and use of land unsuited for row crops. Concurrent with this problem are gasoline, fertilizer and numerous other shortages and an increase in all farming costs. Minimum tillage offers a partial solution to these important farming problems. The Soil Conservation Service

(U.S. Dept. Agr. 1971) pointed out that labor, machinery and fuel costs are cut with minimum tillage practices by reducing the amount of work required to obtain a crop. Soil moisture is conserved and, thus, less irrigation water is necessary. Wind and water erosion are reduced which benefits not only the farmer, but everyone, by diminishing air and water pollution. Furthermore, the stalks, leaves and seeds benefit pheasant (Phasianus colchicus), quail (Colinus virginianus and Callipepla squamata), dove (Zenaidura macroura) and turkey (Meleagris gallopavo). This study further indicates minimum tillage to be of extreme importance to the lesser prairie chicken.

Soil factors were also important to lesser prairie chicken populations. During the spring sampling periods of each year, there was a particularly high, positive correlation (1972, r = .84; 1973, r = .86) between percent deep sand and bird populations. This fact emphasizes the reliance of this bird on shin oak-bluestem sandhills. Such areas are especially important for nesting and various other types of cover. Negative correlations were found with percent sandy land and percent sandy loam. These areas do not support shinnery oak and tall grasses and are not considered to be desirable lesser prairie chicken habitat.

Dwarf half-shrub cover, primarily broom snakeweed (Xanthocephalum Sarothrae), demonstrated a strong, negative correlation with population size during the spring sampling periods. Such cover is characteristic of sandy land and sandy loam soils. Also, broom snakeweed provides little in fulfilling the requirements

of this bird. Total shrub cover was correlated with populations in all periods except fall, 1973. However, the simple correlations were very small and the relationship inconsistent.

Short and mid grass cover appeared to be important during only one sampling period each. Short grass was negatively correlated with bird populations in spring, 1972 and mid grass was negatively correlated in fall, 1973. Tall grass cover was positively correlated with population size during the fall sampling periods. Total grass cover was correlated twice with populations but was inconsistent in its relationship. These results again indicate the need for the tall grasses of sandhill areas to maintain lesser prairie chicken populations. The inconsistency in the relationship of total grass cover may be explained as a difference in precipitation between the two fall sampling periods. In September and October of 1972, 7.1 inches of precipitation were reported, whereas during the same period of 1973 only 1.19 inches were recorded (U.S. Dept. Comm. 1972, 1973). Grasses for food and cover may have been much more important in 1973.

Short and total forb cover were positively correlated with lesser prairie chicken populations in 1973. Mid forb cover was negatively correlated with population size during the fall of 1973. During that same sampling period, total forb cover was positively correlated. As shown by dietary analysis, forbs are an important fall food source. Jones (1963) found the greatest number of insects produced in plant associations with the highest number of forbs. Jones (1964a) also found forb areas to be important for brood habitat. Thus, forbs contribute doubly as a food source. It is

possible that the importance of forbs is overshadowed by the heavy reliance of birds in the West Texas area on grain sorghum for fall food.

Areas which received 2,4,5-T brush control once in 1968 demonstrated a positive relationship with lesser prairie chicken populations. Those areas which were sprayed twice between 1959 and 1963 were negatively correlated with populations. Over 90 percent of study areas 1 and 2 received spray brush control twice between 1959 and 1963. Since both of these areas consist of 100 percent rangeland, it is possible the absence of the important grain sorghum food source influenced correlations of variables of these two areas with other study areas. A further relationship of brush control and the amount of forb cover may also help to explain these correlations. The simple correlations of twice sprayed areas to percent short forb cover was -.40, percent mid forb cover -.65 and percent total forb cover -.58. Whereas, the relationship of once sprayed areas to percent short forb cover was .91, percent mid forb cover -.09 and percent total forb cover .85. The small amount of forb cover on twice sprayed brush controlled areas may be responsible for the smaller bird populations. The higher percentage of short and total forb cover, found in the more recent once controlled area, may be responsible for larger lesser prairie chicken populations.

During the spring of 1972 and fall 1973, lesser prairie chicken populations were negatively correlated with high range condition. Most of the poor condition rangeland had little or no grazing. Several of these areas were reverted cropland. Smith (1940)

in Oklahoma found more species and higher populations of insects, especially grasshoppers, in mid seral stages than in climax. Nerney (1958) discovered the preferred habitat of many grasshoppers was range in poor condition. It is possible that this food source available on poorer rangeland was responsible for higher lesser prairie chicken populations.

Human activity which results in lek disturbance must also be considered in a discussion of land use. On study lek A, the lek was apparently not disturbed by plowing the land on which the lek was situated. However when surrounding native rangeland was broken for cultivation, the lek was abandoned. In other terms, when the lek was located on a nine section area consisting of 11 percent cultivation, it remained intact. When the area was converted to 56 percent cultivation, the lek was abandoned. Study lek C consisted of 14 percent cultivation before a portion of the land containing the lek was broken. After breaking, 20 percent of the area was under cultivation. Apparently, this disturbance caused abandonment of the lek. Results from study leks A and C indicate that plowing the lek itself may not be as detrimental as the destruction of the native habitat adjacent to the lek.

Study lek B and its comparison area indicate that building a road through the lek may in itself not seriously affect the birds. Indeed, a portion of the infrequently used road contained part of the lek. Some other factors, such as traffic disturbance or the height of the road surface may also be the cause of lek abandonment. An elevated road which would restrict the field of view of the birds may

be more harmful than a nonelevated road. While conducting this portion of the study, frequent use of deserted oil pads by lesser prairie chickens for leks was noted. These areas are covered with caliche and have little or no vegetation on them. They appear to make favorable lek sites. Further discussion with area landowners and Texas Parks and Wildlife personnel confirmed frequent use of these sites for leks.

Importance of the Lesser Prairie Chicken

The lesser prairie chicken was once a common bird in the southern plains of North America. Quite likely, it was an important food source for some Indian tribes and early white settlers. Today, it provides a rare and pleasurable experience for sportsmen during the short hunting season. According to Herb Kothman (personal communication), Biologist, Texas Parks and Wildlife, both the harvest and the number of hunters in West Texas are increasing. As hunter interest expands, revenue from licenses, arms and ammunition will also increase. Also, the lesser prairie chicken provides additional income to area services, such as gasoline stations, motels and restaurants.

Another facet of the importance of this bird is in regard to interest by bird watchers and naturalists. Because of its lek-forming behavior, there is a definite demand for areas to observe the courtship activities of this species. During the course of this study, over 100 individuals have accompanied me specifically to observe and photograph this rare and delightful bird. Currently,

there are no public areas in West Texas where the birds may be observed. I believe that public access areas with blinds erected near the leks would receive considerable use during the appropriate seasons.

A more sublime role, but nevertheless of great importance, is performed by the lesser prairie chicken as a natural component of the ecosystem in West Texas. This bird fills the niche of a seed eater and insect consumer. In turn, it provides food for predators and scavengers and participates in the energy flow and nutrient cycling of the ecosystem. The lesser prairie chicken has filled this niche in the North American Prairie for millions of years. A number of prairie species have vanished due, in part, to extensive human modifications of the prairie ecosystem. A great deal of the land has been plowed and much has been severely overgrazed. As native plants were replaced with a grain monoculture, the ecosystem became unbalanced. The ecosystem must be artifically shoreded up with biocides and fertilizers.

We certainly need food, fiber and fuel and, the prairie region produces many of these necessities. However, it must be determined to what extent ecosystem simplification will be necessary to insure continued prosperity of this country. If the lesser prairie chicken perishes, it will be but a symbol of numerous other plants and animals that will also vanish and an indicator of the extent to which the natural ecosystem has been degraded.

The numbers and distribution of this species have been greatly reduced in modern times. Severe overgrazing and continued breaking of the land will modify the habitat to an extent to which this bird cannot adapt. However, if recognition of the remaining natural ecosystem as a resource compatible with human use and wildlife is made, the lesser prairie chicken and other forms of life associated with it will remain as an important part of our heritage.

CHAPTER V

MANAGEMENT RECOMMENDATIONS

1) The greatest potential threat to the lesser prairie chicken in West Texas is breaking remaining native rangeland for cultivation. Most of the remaining good prairie chicken habitat is shinnery oak sandhills. Because of poor soil and water scarcity, these sandhills produce poor crops. Maintenance of the sandhills in native vegetation for cattle grazing is the optimum resource use for those areas. The lesser prairie chicken requires relatively extensive amounts of native range. Severe overgrazing of these areas should be avoided to preserve the landowners range resource and to provide proper wildlife food and cover.

2) In areas consisting of extensive tracts of rangeland, supplemental plantings of grain sorghum will provide an important fall, winter and early spring food source. Several small plantings should be used rather than a single large tract. Copelin (1963) suggests supplemental food plantings varying in size from 7 to 20 acres. In this manner, birds will be less concentrated and therefore less susceptible to predation and disease problems. Copelin (1963) suggests birds should have to travel no more than two miles to food. Depending on the habitat, I believe supplemental food plantings should be within one mile of the lek.

3) Where cultivation adjoins rangeland, minimum tillage farming techniques should be encouraged. Minimum tillage can cut farming costs, reduce erosion, and improve the soil. Furthermore, minimum tillage affords maximum availability of grain sorghum for wildlife throughout the major part of the year, especially in winter when native foods are scarce.

4) Permanent water impoundments, where none currently exist, may enhance lesser prairie chicken populations. Since birds have been found using free water in spring, summer and fall, the water sources should be permanent. Water should be available within one mile of the lek.

5) Physical disturbance of the lek should be avoided. More importantly, the habitat surrounding the lek should remain intact. Frequent lek disturbances, as would occur with automobile traffic, may result in lek abandonment. To encourage a population or to make birds available for observation, lek sites may be created. Since deserted oil pads were commonly used for leks, a new lek should approximate these in appearance. Caliche can be used to construct the lek. The size of the roughly circular area should be about 100 yards in diameter.

6) Where the quality of the habitat is such that lesser prairie chicken populations are at least maintaining themselves, the surplus may be harvested during a hunting season. If the lesser prairie chicken were to lose its status as a game bird, hunter interest would be lost and money and research devoted to maintaining this bird would probably be reduced. Currently the number of birds

harvested in the West Texas area is approximately 10 percent of spring population size (Herb Kothman, personal communication). Apparently, a harvest of this size has had no deleterious affects on the population. Many factors, such as prolonged severe drought, severe overgrazing or increased breaking of native rangelands, may reduce populations to where no harvestable surplus is produced. Thus, populations must be closely monitored to determine if they are capable of supporting limited hunting.

CHAPTER VI

SUMMARY

1) The lesser prairie chicken is a rare and vanishing native grouse. This once abundant bird has undergone serious reductions in range and numbers. Since the lesser prairie chicken is dependent on large tracts of native rangeland, populations are sensitive to human land use. A study to determine the effects of land use on populations of this bird in West Texas was conducted from October, 1971 to February, 1974. A review of the literature indicated only limited information exists regarding the management of this species.

2) Range condition, grazing intensity, brush control, cultivation and vegetation cover were used to determine land use. Lek counts were used to census bird populations on eight study areas in the spring and fall of 1972 and 1973. Multiple regression analyses were made to discover which land-use and habitat factors were most influential on bird populations. Partial and total physical disturbances of the lek were studied on four additional areas. Spring water requirements were examined by observation of time and amount of use of man-made water impoundments. Fall diets were determined from crops collected during the mid-October hunting season.

3) Results of the statistical analyses of land use and bird populations indicate the importance of having from 63 to 95 percent

rangeland and the remainder in grain sorghum in order to maintain maximum numbers of birds. Leks on areas with limited cultivation averaged 24.0 males in spring and 35.9 birds in fall and the next nearest lek averaged 1.5 miles away. Study areas with no cultivation had lower average spring (11.9 males) and fall (25.7 birds) populations. The next nearest lek on these areas averaged 2.0 miles. Areas of less than 63 percent native rangeland appear to be incapable of supporting stable populations under existing methods of land use. Because of the importance of grain sorghum as a food source, use of minimum tillage farming techniques will enhance lesser prairie chicken populations. The combined influence of soil, vegetation and land use is demonstrated as being of importance to maintain populations. Man-made water impoundments were used for drinking water during a period of spring drought and may increase survival during such critical periods. Disturbance of the lek by plowing or construction of a frequently used road through the lek may result in abandonment.

4) Management recommendations include preservation of remaining native rangeland. Severe overgrazing of these areas should be avoided. Supplemental plantings of grain sorghum in large tracts of native rangeland provide an important fall, winter and early spring food source. The practice of minimum tillage farming should be encouraged, not only to benefit wildlife, but also to cut farming costs, reduce erosion and improve the soil. Permanent water impoundments should be constructed to provide birds with a source of

drinking water. Destruction of the lek and surrounding habitat should be avoided. The population should be monitored annually to determine whether a harvestable surplus has been produced.

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APPENDIX

A. Summary of autumnal diet of the lesser prairie chicken in West Texas:1971-73.

B. Diet analysis of single lesser prairie chicken crop from spring, 1973.

C. Scientific names of plants listed in text.

APPENDIX A: Summary of autumnal diet of the lesser prairie chicken in West Texas: 1971-73.

Plant Foods	Scientific Name	Type	% Frequency	% Weight [a]	% Volume [a]
Grain sorghum	Sorghum vulgare	seeds	55.6	62.0	43.5
Shin Oak	Quercus Havardii	galls	39.7	8.0	15.3
		acorns	15.9	7.1	5.0
		leaves	7.9	0.1	0.3
Flax	Linum rigidum	seeds	20.6	1.6	2.3
Spurge	Euphorbia Fendleri	leaves & seeds	12.7	0.5	0.8
Rayed Palafoxia	Palafoxia sphacelata	leaves & flowers	7.9	1.6	2.1
Sunflower	Helianthus annuus	seeds	4.8	3.3	2.8
Alfalfa	Medicago sativa	leaves	4.8	1.0	1.6
Ratany	Krameria spp.	leaves	4.8	0.5	0.8
Day-flower	Commelina erecta	leaves	4.8	0.1	0.4
Fall Witchgrass	Leptoloma cognatum	leaves	4.8	+	0.1
Wheat	Triticum aestivum	seeds	3.2	1.7	1.1
Wild buckwheat	Eriogonum annuum	leaves & seeds	3.2	0.9	1.7
Gaura	Gaura spp.	seeds	3.2	0.9	0.6
Flatsedge	Cyperus spp.	leaves	3.2	0.2	0.3
Crabgrass	Digitaria spp.	leaves	3.2	0.1	0.2
Russianthistle	Salsola Kali	leaves	3.2	0.1	0.1
Sand Paspalum	Paspalum setaceum	seeds	3.2	0.1	0.1
Doveweed	Croton spp.	leaves & seeds	1.6	0.3	0.5
James Rushpea	Caesalpinia Jamesii	seeds	1.6	0.1	0.7
Greenthread	Thelesperma spp.	leaves	1.6	0.1	0.2
White-top	Erigeron strigosus	flowers	1.6	+	0.1
Six-weeks Fescue	Vulpia octoflora	leaves	1.6	+	+
Pigweed	Amaranthus spp.	seeds	1.6	+	+
Unidentified		leaves	9.5	0.1	0.3
Unidentified		seeds	7.9	0.1	0.2

APPENDIX A. Continued.

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Plant Foods	Scientific Name	Type	% Frequency	% Weight [a]	% Volume [a]
Unidentified	Compositae	seeds & flowers	4.8	0.1	0.1
Unidentified	Gramineae	leaves & seeds	6.4	0.1	0.2
Unidentified		woody material	1.6	+	+
Total Plant Material			100.0	90.0	81.0

Animal Foods	Family	% Frequency	% Weight	% Volume
Darkling Beetles	Tenebrionidae	23.8	0.6	1.7
Short-horned Grasshoppers	Acrididae	19.1	5.6	11.9
Ants	Formicidae	7.9	0.1	0.1
Leaf Hoppers	Cicadellidae	6.4	+	0.1
Walkingsticks	Phasmidae	4.8	1.9	2.2
Wingless long-horned Grasshoppers	Gryllacrididae	3.2	0.7	1.4
Cutworms	Noctuidae	3.2	0.3	0.7
Ground Beetles	Carabidae	3.2	0.2	0.5
Leaf Beetles	Chrysomelidae	3.2	+	0.1
Long-horned Beetles	Cerambycidae	1.6	+	+
Weevils	Curculionidae	1.6	+	+
Broad-headed Bugs	Coriscidae	1.6	+	+
Scentless Plant Bugs	Corizidae	1.6	+	+
Unidentified	Insecta	3.2	+	+
Total Animal Material		42.9	10.0	19.0

[a] + indicates less than 0.05%

APPENDIX B: Diet analysis of single lesser prairie chicken crop from spring, 1973

Plant Foods	Scientific Name	Type	% Weight	% Volume
Grain Sorghum	Sorghum vulgare	seeds	63.1	48.6
Easter Daisy	Townsendia exscarpa	leaves & flowers	36.5	50.8
Shinnery Oak	Quercus Havardii	leaves	0.3	0.3
Total Plant Material			99.9	99.7

Animal Foods	Family	% Weight	% Volume
Unidentified Beetle	Coleoptera	0.1	0.3
Total Animal Material		0.1	0.3

APPENDIX C: Scientific names of plants listed in text. [a]

Shrubs	
Broom Snakeweed	*Xanthocephalum Sarothrae*
Catclaw Mimosa	*Mimosa biuncifera*
Mesquite	*Prosopis glandulosa*
Sand Sagebrush	*Artemisia filifolia*
Shin Oak	*Quercus Havardii*
Skunkbush Sumac	*Rhus aromatica*
Yucca	*Yucca* spp.
Forbs	
Camphorweed	*Heterotheca villosa*
Cryptantha	*Cryptantha Jamesii*
Dalea	*Dalea* spp.
Evening Primrose	*Oenothera rhombipetala*
Nama	*Nama hispidum*
Pepperweed	*Lepidium densiflorum*
Plantain	*Plantago patagonica*
Sensitive Briar	*Schrankia uncinata*
Sleepy-Daisy	*Xanthisma texanum*
Spectable-Pod	*Dithyrea Wislizenii*
Spiny Haplopappus	*Machaeranthera pinnatifida*
Spotted Beebalm	*Monarda punctata*
Wild Flax	*Linum rigidum*
Yellow Woolywhite	*Hymenopappus flavescens*
Zinnia	*Zinnia grandiflora*
Grasses	
Blue Grama	*Bouteloua gracilis*
Buffalo Grass	*Buchloe dactyloides*
Grassbur	*Cenchrus incertus*
Hooded Windmill Grass	*Chloris cucullata*
Little Bluestem	*Schizachyrium scoparium*
Needle and Thread Grass	*Stipa comata*
Purple Threeawn	*Aristida purpurea*
Sand Bluestem	*Andropogon Hallii*
Sand Dropseed	*Sporobolus cryptandrus*
Wright's Threeawn	*Aristida Wrightii*

[a] The nomenclature follows Correll and Johnston (1970).