HABITAT EVALUATION FOR LESSER PRAIRIE CHICKENS IN EASTERN CHAVES COUNTY, NEW MEXICO

BY

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A Thesis submitted to the Graduate School
in partial fulfillment of the requirements
For the Degree
Master of Science

Major Subject: Wildlife Science

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ABSTRACT

HABITAT EVALUATION FOR LESSER PRAIRIE CHICKENS
IN EASTERN CHAVES COUNTY, NEW MEXICO

BY

H. RUSSELL SUMINSKI, B.S.

Master of Science in Wildlife Science

New Mexico State University

Las Cruces, New Mexico, 1977

Dr. Charles A. Davis, Chairman

Habitat description, habitat use, and food use are reported for a population of lesser prairie chickens (*Tympanuchus pallidicinctus* Ridgway) in Chaves County, New Mexico, from February, 1976 to January, 1977.

Vegetation of the study area consists of two types, Shinnery Oak-tallgrass and Mesquite-shortgrass. Shinnery Oak-tallgrass includes 4 subtypes, with Subtype 1 having the greatest amount of grass, Subtype 2 the second greatest, etc.

Vertical mist nets, one cannon net, and drop nets were used to capture 21 lesser prairie chickens. Eight females were equipped with miniature radio transmitters in order to study movements and nesting and brood-rearing habitat. Radio-equipped females were quite mobile during early spring, moving 2-3 km in periods of 2-3

days. Known movements of males during spring were short and apparently centered around booming grounds.

Six nest sites of lesser prairie chickens were located. Females appeared to prefer Subtype 1 of the Shinnery Oak-tallgrass habitat type (the most grassy areas present) for nesting habitat. Preferred brood-rearing habitat was much less grassy and correspondingly more brushy than nesting habitat.

Habitat preferred by adults was moderately grazed pastures having an abundance of shinnery oak. Booming grounds were located mostly in Mesquite-shortgrass habitat or in man-caused open areas such as oil pads.

Foods of adult prairie chickens during spring were primarily vegetative material (60.4 percent volume) and mast and seeds (27.5 percent) with shinnery oak parts composing 84.4 percent of the total diet. Young chicks (approximately 2-4 weeks of age) ate insects exclusively, while larger chicks (approximately 6-10 weeks of age) began eating small amounts of vegetation but still consumed mostly insects (98.7 percent of total diet). Fall food items of adult-size lesser prairie chickens were primarily vegetative material (82.6 percent). Insects were of some importance to adult-size birds, composing 12.1 percent of the diet during spring and 17.4 percent during late summer and fall.

Restoration of tallgrass habitat in the more brushy areas, especially in Subtype 4 of Shinnery Oak-tallgrass, is recommended. Plans for future development of new livestock watering facilities in the study area should be curtailed. Establishment of livestock

exclosures to establish nesting habitat in areas where it presently is absent is recommended. Continued research into habitat use and behavior of lesser prairie chickens is recommended strongly.

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INTRODUCTION

During historical times, the lesser prairie chicken (*Tympanuchus pallidicinctus* Ridgway) has been confined to a small geographic range and has existed in relatively small numbers (Greenway 1958). Prior to settlement, the species inhabited eastern New Mexico, southeastern Colorado, southwestern Kansas, western Oklahoma, and a portion of western Texas (Sharpe 1968). Numbers increased temporarily during the late nineteenth century, apparently in response to improved fall and winter food sources supplied by the patchwork type of farming which was widespread in the west at that time. Populations were very low during the great drouths of the 1930's and 1950's, probably in response to loss of suitable habitat (Donaldson 1969). Numbers and range of the lesser prairie chicken now are much reduced in comparison with those of presettlement days, apparently due to grazing and brush control in addition to the great drouths (Hamerstrom and Hamerstrom 1961).

While information on habitat use and habitat loss in the greater prairie chicken (*T. cupido*) is fairly extensive, and it often is presumed that problems relating to the lesser prairie chicken are similar, much less actually is known about the habitat of the lesser prairie chicken. Crawford (1974) found that in Yoakum County, western Texas, areas consisting of 63 to 95 percent native rangeland with the remainder in cultivation, especially grain sorghum, supported the largest populations and bird densities. Areas of 100 percent rangeland were capable of supporting smaller

populations, and areas of less than 63 percent rangeland were incapable of sustaining populations. Crawford also found high positive correlations between lesser prairie chicken numbers and extent of sandy areas, indicating a reliance of this bird on shinnery oak (*Quercus havardii*)-bluestem (*Andropogon* spp.)[1] sandhills. Habitat of the lesser prairie chicken has been described by Copelin (1963) as broad, open expanses of grassland interspersed with brushy vegetation such as shinnery oak and sand sagebrush (*Artemisia filifolia*).

Hoffman (1963), Jackson and DeArment (1963), and Jones (1963) all have stated that lesser prairie chickens need a mixture of grass and shrub types in their habitat. Hoffman (1963) and Jackson and DeArment (1963) further state that reductions in numbers of lesser prairie chickens were due, in part, to increased cultivation, grazing, and brush control, as well as the drouths of the 1930's and 1950's.

The New Mexico Department of Game and Fish has attempted to improve areas of lesser prairie chicken range by construction of exclosures to prevent grazing by cattle (Frary 1957). Although Hoffman (1959) calls this the most important single attempt to restore lesser prairie chickens, very little research has been done in New Mexico which would serve as a basis for accurate evaluation

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[1]Plant nomenclature follows Kearney and Peebles (1964), Anderson and Owensby (1969), Gay and Dwyer (1970), and Barkley (1968). Common and Latin names used herein are listed in Appendix A.

of the effects of grazing or of exclusion of grazing. Frary (1957) attempted to evaluate the effects of these grazing exclosures on lesser prairie chicken populations, and to determine actual habitat use throughout the year, but reported few actual data. Many more research data are needed to establish which components of the habitat are utilized by the lesser prairie chicken throughout the year so that guidelines for future grazing and agricultural practices can be formulated for areas inhabited by the species.

In order to meet the needs identified above, this study was initiated with the following specific objectives: (1) Determine the vegetational characteristics of nesting, brood-rearing, and other seasonally occupied habitat through observation of lesser prairie chickens and (2) Develop management recommendations in terms of vegetational goals for specific habitat features, including spatial requirements of these goals, to maintain a secure population of lesser prairie chickens in the study area.

Field work was conducted full time from February 1976, through August 1976, and was continued periodically from September 1976, through January 1977. Findings, conclusions, and recommendations contained in this report are tentative and subject to modification as further studies are conducted.

STUDY AREA

The study area of approximately 66 km^2 (Fig. 1) is located on national resource lands in the East Chaves Planning Unit of the Roswell, New Mexico District of the U. S. Department of Interior, Bureau of Land Management (BLM). The area is approximately 64 km east of Roswell, and lies north of U. S. Highway 380 and south of U. S. 70. Topography is gently undulating and dunelike.

Vegetation of the area consists of two principal types. The Shinnery Oak-tallgrass type occurs on the deep sandy soils which occupy most of the area, and the Mesquite (*Prosopis juliflora*)-shortgrass type occurs on shallower, tighter soils. These vegetation types will be described in greater detail later. The principal use of the area is for grazing by cattle.

Climate of the study area (Maker et al. 1971) is semi-arid, characterized by distinct seasons, wide ranges of diurnal and annual temperatures, moderately low rainfall, and plentiful sunshine. Temperatures of 90 degrees F. or higher occur on most days from mid-May through mid-September, and temperatures above 100 degrees F. are common from June through August. Nighttime temperatures generally are about 30 degrees cooler. Nearly three-fourths of the annual precipitation falls during the growing season, May through October, mainly from brief but often intense thunderstorms.

Temperatures in 1974, 1975, and 1976 at Bitter Lake National Wildlife Refuge, approximately 60 km west of the study area, are given in Table 1. Average monthly minima and maxima were relatively

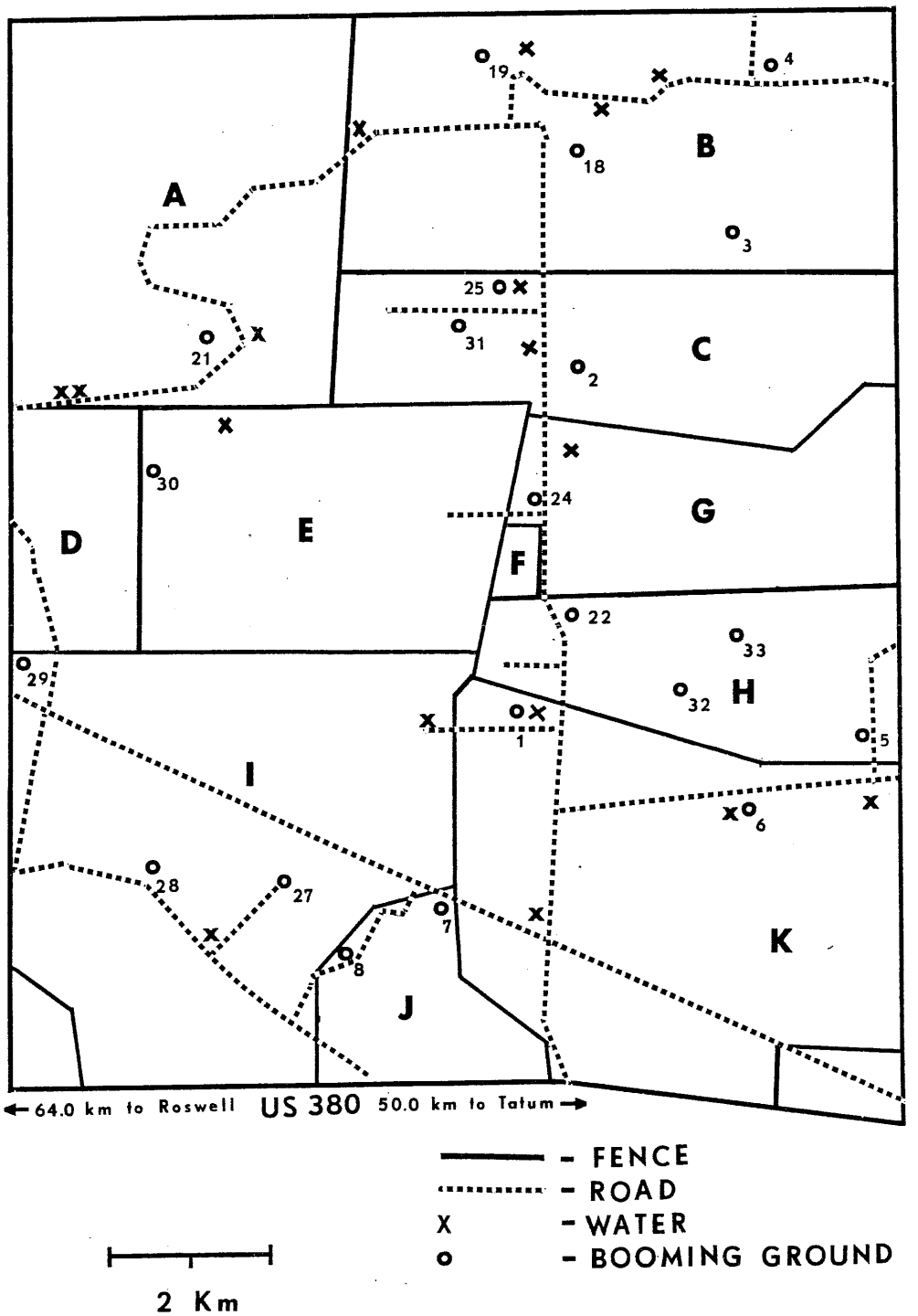

Fig. 1 Study Area

Table 1. Average monthly minimum and maximum temperatures (F), from data recorded at Bitter Lake National Wildlife Refuge, New Mexico during 1974, 1975, and 1976 (U. S. Dept. of Commerce 1974, 1975, 1976).

	1974		1975		1976	
Month	Min.	Max.	Min.	Max.	Min.	Max
January	18.1	57.1	22.0	56.2	15.5	59.4
February	-	63.7	23.5	56.3	26.2	69.3
March	33.9	78.4	28.8	67.1	30.3	70.2
April	41.0	80.1	34.0	73.9	42.1	78.3
May	51.4	91.0	41.2	84.1	48.2	82.3
June	47.3	96.7	53.4	94.8	57.9	94.5
July	62.0	96.3	58.6	88.6	61.6	90.3
August	58.8	87.9	56.1	94.3	59.5	94.4
September	49.9	76.3	48.1	82.8	53.3	82.9
October	45.4	72.4	35.4	81.0	32.9	71.8
November	30.4	63.2	22.4	69.0	25.9	58.1
December	22.0	54.7	17.2	60.8	15.2	56.0

consistent from year to year. Precipitation data from Bitter Lake are given in Fig. 2. Both total amount and temporal distribution of rainfall were similar in 1975 and 1976. Spring of 1976 was somewhat drier than that of 1975, and fall was somewhat wetter, but total amounts of precipitation were similar and both were near the average of approximately 12 inches. Rainfall in 1974 (18.17") was greater than average, due primarily to large amounts falling during July, August, and September, and is not believed to have been typical of rainfall patterns and amounts in the study area.

The study area is occupied by many species in addition to the lesser prairie chicken. Other birds sighted are listed in Table 2. The mammals observed most frequently were the pronghorn (*Antilocapra americana*), coyote (*Canis latrans*), black-tailed jackrabbit (*Lepus californicus*), and spotted ground squirrel (*Citellus spilosoma*). Desert cottontails (*Sylvilagus auduboni*), and badgers (*Taxidea taxus*) were seen occasionally. Sign of bobcat (*Lynx rufus*) was found on several occasions. A large black-tailed prairie dog (*Cynomys ludovicianus*) town is present at the northern end of the study area.

Reptiles observed in the study area included the prairie rattlesnake (*Crotalus viridis*), diamondback rattlesnake (*Crotalus atrox*), massasauga (*Sistrurus catenatus*), milksnake (*Lampropeltis triangulatum*), coachwhip (*Masticophis flagellum*), bullsnake (*Pituophus melanoleucus*), and western hognose snake (*Heterodon nasicus*). Several species of lizards, mostly *Cnemidophorous* spp., were common.

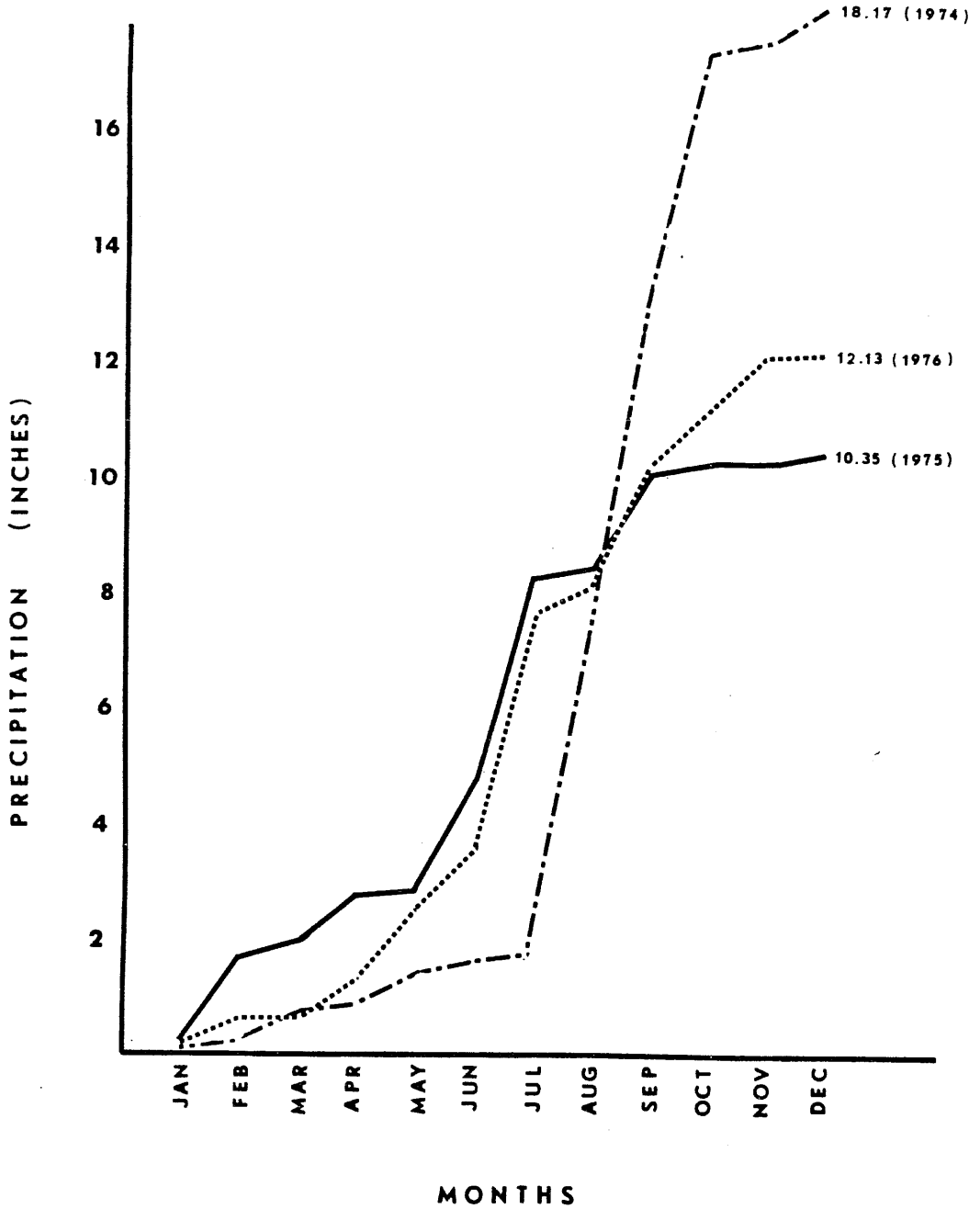

Figure 2. Cumulative precipitation at Bitter Lake National Wildlife Refuge, New Mexico (U. S. Dept. of Comm. 1974, 1975, 1976)

Table 2. Birds observed in the study area from February 1976 through January 1977. (after Robbins et al. 1966)

Turkey vulture (*Cathartes aura*)
Coopers hawk (*Accipiter cooperii*)
Marsh hawk (*Circus cyaneus*)
Ferruginous hawk (*Buteo regalis*)
Swainson's hawk (*Buteo swainsoni*)
Golden eagle (*Aquila chrysaetos*)
Prairie falcon (*Falco mexicanus*)
Sparrow hawk (*Falco sparverius*)
Scaled quail (*Callipepla squamata*)
Bobwhite (*Colinus viginianus*)
Killdeer (*Charadrius vociferus*)
Mourning dove (*Zenaidura macroura*)
Roadrunner (*Geococcyx californianus*)
Burrowing owl (*Speotyto cunicularia*)
Common nighthawk (*Chordeiles minor*)
Western kingbird (*Tyrannus verticalis*)
White-necked raven (*Corvus cryptoleucus*)
Rock wren (*Salpinctes obsoletus*)
Starling (*Sturnus vulgaris*)
Eastern meadowlark (*Sturnella magna*)
Western meadowlark (*Sturnella neglecta*)
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)
Loggerhead shrike (*Lanius ludovicianus*)
Lark bunting (*Calomospiza melanocorys*)
Pyrrhuloxia (*Pyrrhuloxia sinuata*)

METHODS

Vegetation

Data were recorded at individual use-sites (e.g., foraging sites) from a cluster of eight 10-foot, line-point transects with data points at one-foot intervals and radiating from the center of the site. Data from nest sites were taken from similar transect clusters, except that these transects extended 30 feet and provided 240 data points per cluster. Similar data were taken from both types of transects. Bare ground, litter, or plant species present (basal) was recorded for each point. The species of plant on the point, or nearest and in front of the point if the point was on bare ground or litter, was recorded. Presence or absence of canopy above 0.3 m in height was recorded and, if present, the species providing the canopy cover was recorded. Height was measured to the nearest centimeter for the plant nearest the center of each cluster and for the plant nearest each third data point on each transect, yielding 25 height measurements for each 10-foot transect cluster. Height of vegetation covering nests was recorded separately, and height was measured at every third point on the 30-foot transects, yielding 80 measurements per transect cluster around each nest site.

Clusters of paced transects were used to gather data for description of vegetation subtypes and to gather additional data at nest sites. Each of these clusters consisted of four transects radiating on principal compass bearings from a center point. The observer walked 100 steps on each transect with the toe of the right

boot being the data point. This gave 50 data points per transect and 200 points per cluster. Bare ground, litter, or plant was recorded for each point, and the species of plant at the toe or the one nearest and in front of the toe was recorded as for the smaller transect clusters.

Height and livestock utilization of 24 randomly selected plants each of sand bluestem (Andropogon hallii), little bluestem (A. scoparius), and dropseeds (Sporobolus spp.) were recorded for the area within 30 feet of each nest site. The height of each plant in the sample was measured in centimeters, and utilization was estimated by ocular comparison with other plants of the same species. In some cases there were fewer than 24 plants of each species within 30 feet of the nest site. In this case, the sample was considered complete when it contained all plants present in this area.

Brood Habitat

An index was developed to measure relative use of all types of habitat by broods of young prairie chickens. Data were collected while walking 6 routes on north-south axes across each square mile of 20 areas selected throughout the study area. All broods and/or fresh brood sign encountered were recorded. These data were compiled to produce the index, number of brood (or sign) observations/hour/km^2 for each area sampled.

Trapping

Trapping was begun on 15 March 1976, with the specific objective of capturing 8 female lesser prairie chickens for use in the telemetry portion of the study. A total of 11 males and 10 females were captured during 32 days of trapping. One male and 1 female died as a direct result of trapping, resulting in a mortality rate of 9.5 percent. The females were caught on 21, 29, and 31 March and 5, 7, 8, 9, 12, and 15 April, indicating late March to mid-April as the best period for capturing females in this area.

Several trapping procedures were used on seven individual sites. Four of these sites were on or adjacent to booming grounds, and three of the sites were watering facilities known to be used by the birds. For example, a watering tub on booming ground No. 1 was the specific trapping site on that ground. All birds were captured at the sites on or near booming grounds.

Use of vertical mist nets (Campbell 1972) was the most effective method (Figs. 3 and 4). Sixteen of 21 birds captured were caught in these nets. Mist nets were used more than were other types because they were easier to work with and were more effective in our situation. Each mist net was 20 m long by 4 m high with 5 cm mesh. On one of the larger booming grounds, three nets were used simultaneously. On the first day of trapping, the attempt was made to flush birds into the net by walking toward them from a distance of approximately 300 m. The birds flushed from a distance of about 100 m, and all flew over or around the nets. After some

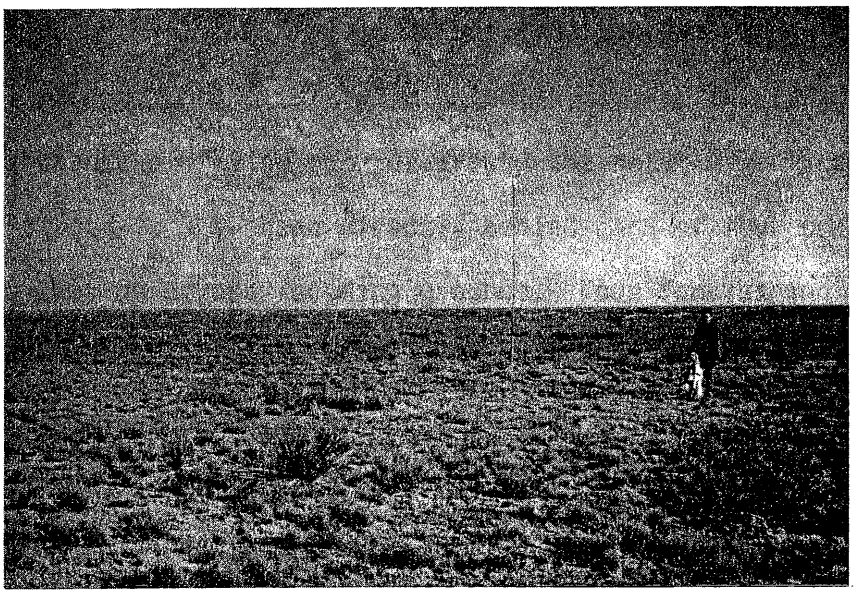

Fig. 3 Vertical mist net on booming ground No. 2.

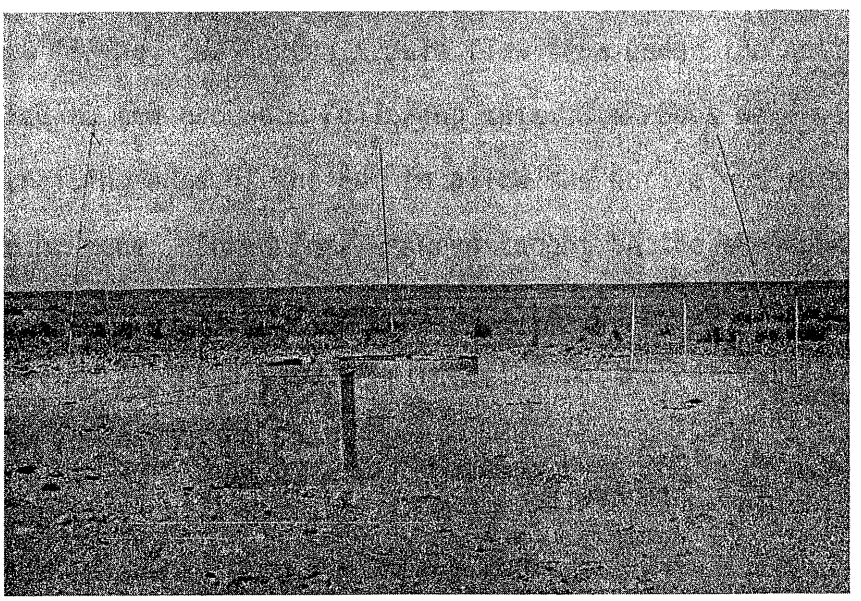

Fig. 4 Vertical mist net at watering tub.

experimentation, it was found that placing a blind at a distance of 10 m from the net and flushing specific birds (females) into the net was most successful. At this distance, positive sex identification could be made (Campbell 1972, Edminster 1954), and the target bird had less chance of flying over or around the net. A vertical mist net was placed in a V-shape directly behind each of four small watering tubs on or near booming grounds. Four females and several males were caught in these nets. It was necessary to place considerable slack in the net in order to insure entanglement of the bird. On several occasions, nets were strung too tightly and birds flushed into them merely bounced out and flew away.

A 10 m x 20 m 3-cannon net was in place on one booming ground throughout the entire trapping period. The net was fired 3 times, and 3 females were caught. The net was placed to cover an area where females were known to gather on the edge of the booming ground. On the first firing, the target female flew from under the net before it settled to the ground. Following this, 3 m ropes were attached to the trailing edge of the net to allow the entire net to move forward 2 m or more. Three females were caught on the subsequent 2 firings of the net. The probability of capturing the target bird seemed better if the bird was walking toward the net rather than away from it.

Inclined mist nets (Silvy and Robel 1968) were used briefly, but without success. Two 8 m x 12 m drop nets with 4.5 cm mesh also were used. One was placed on each of 3 different booming grounds at various times. The birds were not attracted to grain baits, so the

drop nets were placed over well-used entrance and exit routes to booming grounds. These nets seemed to have minimal effect on the birds' behavior, and males were observed under them on several occasions. One male was captured with a drop net while its operation was being tested. No females were captured with these drop nets, but this may have been due to chance rather than avoidance of the nets by females.

A grouse brood trap (Tomlinson 1963) was used in several attempts to recapture a female in order to replace the battery in the transmitter carried by the bird. These efforts failed because neither the female nor her brood could be driven into the trap. When drivers came close to the birds, the young hid or ran while the female flushed in another direction in an attempt to draw the drivers away from the brood.

Telemetry

Eight female lesser prairie chickens were equipped with miniature radio transmitters so their movements and nesting and brooding habitat could be studied. The transmitters were built by Sidney L. Markusen of Esko, Minnesota, and transmitted on frequencies of 150-155 mHz. The transmitter package consisting of the transmitter, battery, and harness weighed approximately 20 g and was similar to the one described by Brander (1968). Movements of females were monitored using a portable receiver and either a vehicle-mounted or hand-held yagi antenna purchased also from Markusen. The usual procedure was to begin with the antenna mounted atop a truck for scanning and for making initial radio contact with

a particular female. Then, the antenna was hand-carried during close tracking to determine the exact location of the bird.

Two attempts were made in late spring to locate missing females by aerial search. A Piper 140 aircraft with a yagi antenna attached under the fuselage was used for these searches. Flights were made at a height of 60 m and an average ground speed of 120 kph. During these flights, signals from functioning transmitters were received from a distance of over 3 km.

Other Marking

A number of males were caught during the attempts to capture females. Eight of these were marked with colored back tags, with a different colored tag for each booming ground where males were caught. The tags were made of nylon cloth, approximately 25 mm x 75 mm, and were attached to the nape of the neck by a medium-sized safety pin. This marking was incidental to the main study, and was done in an attempt to obtain indications of fidelity of males to individual booming grounds.

Nine birds, 4 males and 5 females, were banded with standard aluminum leg bands. As yet, none of these bands have been recovered.

Food Habits

Thirty-three lesser prairie chickens were collected by shooting in the study area from March, 1976, through December, 1976. Contents of each crop or gizzard studied were analyzed separately. Foods were measured by volume displacement to the nearest 0.1 ml,

and items composing less than 0.1 ml were classified as "trace." Composition of the diet was determined by the aggregate percent method (Martin et al. 1946).

RESULTS AND DISCUSSION

Habitat Types

Two principal habitat types, Shinnery Oak-tallgrass and Mesquite-shortgrass, are present (Fig. 5). The four subtypes of Shinnery Oak-tallgrass (Table 3) are distinguished primarily by relative quantities of total grass present. Subtype 1 has the greatest amount of grass, Subtype 2 the second greatest, etc. The outstanding indicator species is sand bluestem: it declines in quantity from Subtype 1 through Subtype 4 in the same manner as do total grasses. Somewhat the reverse is true for little bluestem and for three-awns (*Aristida* spp.). These species represent larger percentages of the vegetation in the subtypes where sand bluestem is less abundant.

The abundance of grasses in Subtype 1 is accompanied by a relative lack of forbs. These are more abundant in the other subtypes but no progressive change through Subtypes 2, 3, and 4 is evident. Conversely, woody species, especially shinnery oak, are in greatest relative quantity in Subtype 4, where they compose a larger percentage of the total vegetation than do grasses.

Vegetation in areas of Mesquite-shortgrass was not sampled because such areas received little use by prairie chickens. Conspicuous plants on these areas included mesquite, broom snakeweed (*Gutierrezia sarothrae*), and several species of short grasses, notably grama (*Bouteloua* spp.).

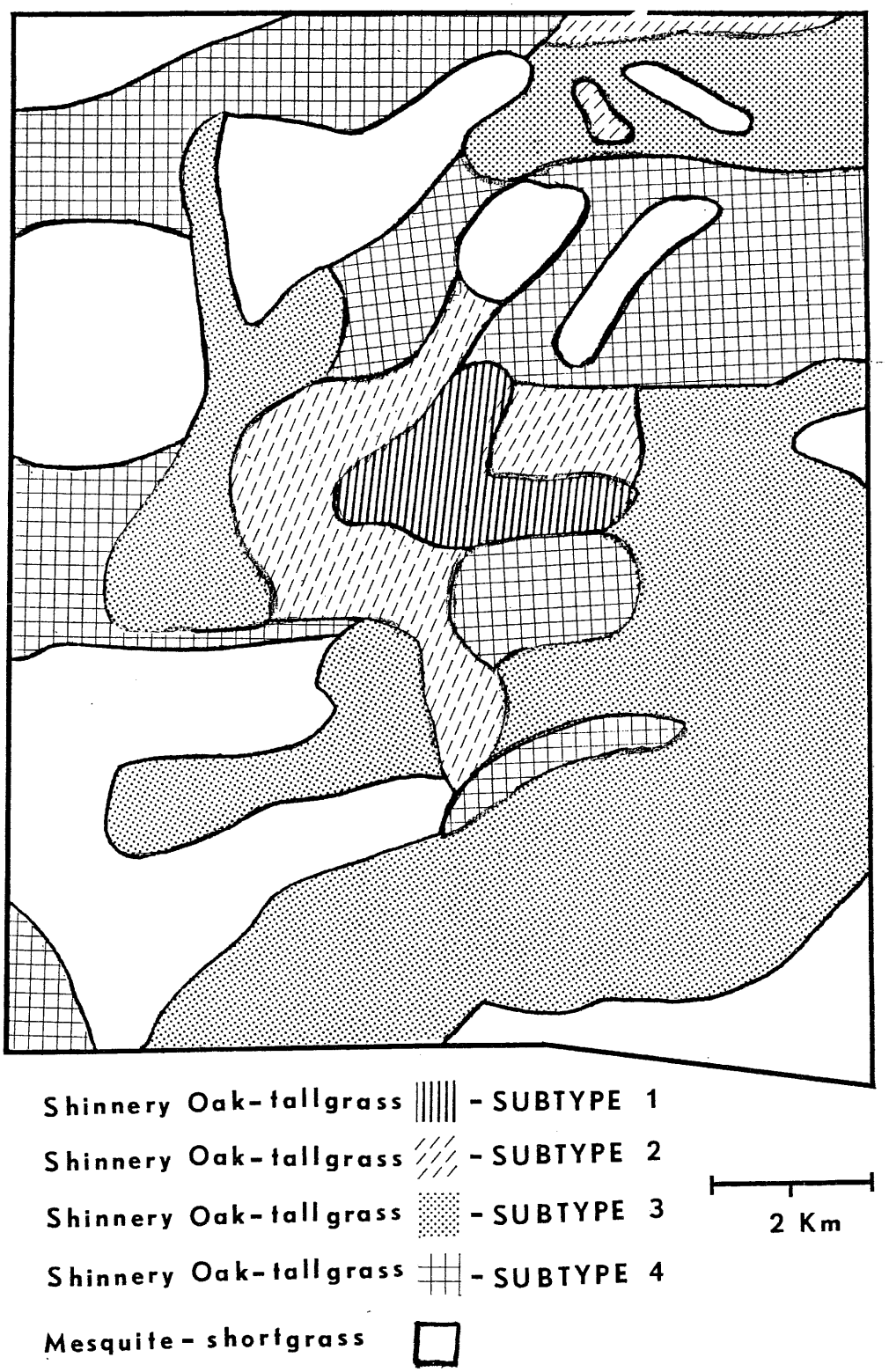

Fig. 5 Habitat types and subtypes on study area.

Table 3. Percent basal composition of vegetation in the Shinnery Oak-tallgrass habitat type.

Species	Percent Composition			
	Subtype 1 (8)[1]	Subtype 2 (8)[1]	Subtype 3 (8)[1]	Subtype 4 (32)[1]
Sand bluestem	25.6	8.6	5.6	5.0
Little bluestem	4.9	9.5	9.3	5.8
Threeawns	7.9	16.1	22.0	13.3
Hairy grama	7.8	4.7	3.6	3.8
Dropseeds	6.6	7.2	4.5	5.5
Hall's panicum	4.1	4.0	4.4	4.5
Sand lovegrass	1.2	2.3	2.3	0.9
Paspalum	1.1	1.2	2.0	1.9
False buffalograss	0.2	3.2	-	1.1
Trace species[2]	0.3	0.2	-	0.1
Total Grass	59.7	57.0	53.7	41.9
Shinnery oak	37.8	32.4	37.3	43.9
Sand sagebrush	0.6	0.1	1.2	1.0
Yucca	0.4	1.8	1.6	0.7
Trace species[2]	0.4	0.4	0.1	0.3
Total Shrubs	39.2	34.7	40.2	45.9
Western ragweed	0.3	3.0	1.2	1.1
Cryptantha	0.1	0.6	0.4	0.7
Guara	0.1	0.6	0.1	0.1
Euphorbia	-	1.3	0.4	3.7
Chaffweed	-	0.7	0.3	1.5
Hymenopappus	-	0.1	1.4	0.7
Bundle flower	-	-	0.8	0.5
Trace species[2]	0.6	2.0	1.5	3.9
Total Forbs	1.1	8.3	6.1	12.2
Percent Ground Cover				
Plant	19.9	14.9	10.6	9.2
Litter	42.0	31.6	36.4	31.7
Bare	38.1	53.5	53.0	59.1

[1]Number of transect clusters run in each subtype

[2]Species making up less than 0.5% each of total composition.

Booming Grounds

Jones (1963) and Copelin (1963) found that lesser prairie chickens in Oklahoma usually chose shortgrass sites on high ground for booming grounds. This combination of short vegetation and higher elevation gave the booming chickens visibility of the surrounding area. Jones, however, did locate some smaller grounds in areas of the mid-grass type. Donaldson (1969) also found that lesser prairie chickens in Oklahoma used areas of rather low vegetation for booming grounds, with these sites usually being located on ridges. He found, also, that booming grounds located in areas where vegetation grew rapidly as the season progressed were abandoned earlier in spring than were those on which growth was less rapid.

Booming grounds were located throughout the study area on a variety of sites (Table 4). Several were on or adjacent to oil "pads" left in the area after oil exploration work several years earlier (Fig. 6). These pads are areas approximately 50 to 75 meters square which have been treated to establish a flat, hard surface to support drilling equipment used in this sandy area. The pads provided sites with little or no vegetation to limit visibility of displaying males, and were used extensively as booming grounds. Most of the consistently used booming grounds on natural sites were in areas of tight soils characterized by the Mesquite-shortgrass habitat type (Fig. 7).

Numbers of males found on booming grounds which were closely monitored gradually decreased during March and April, and then

Table 4. Site descriptions of known booming grounds.

Ground Number	Site: Oil Pad	Site: Mesquite Short Grass	Site: Shinnery Oak Tall Grass	Status: Pre-Existing	Status: New
1	x			x	
2		x		x	
3*			x	x	
4*			x	x	
5*			x	x	
6	x			x	
7*	x			x	
8*	x			x	
18*			x	x	
19		x		x	
21		x		x	
22	x			x	
24			x	x	
25		x			x
27			x		x
28	x			x	
29	x				x
30		x			x
31			x		x
32			x		x
33			x		x

*Believed not to be used during 1976.

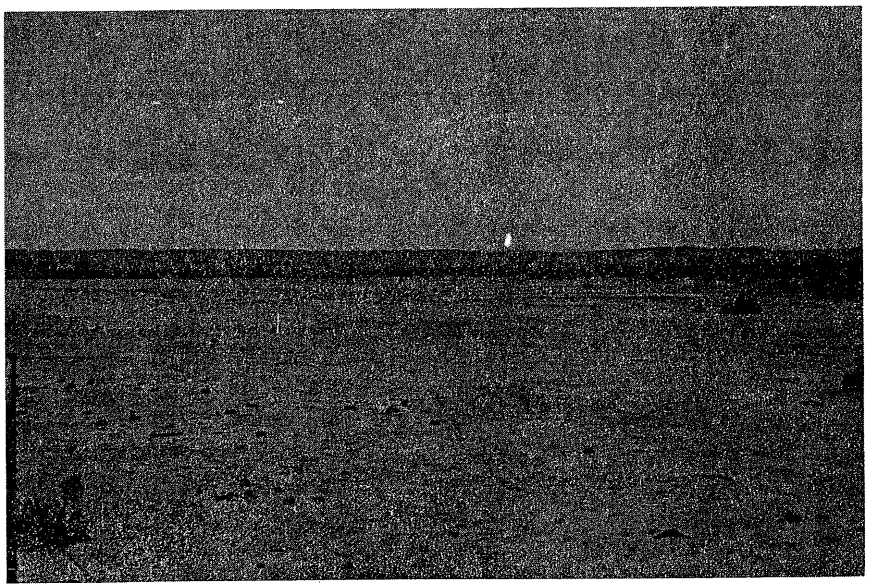

Fig. 6 Booming ground No. 22 (oil pad).

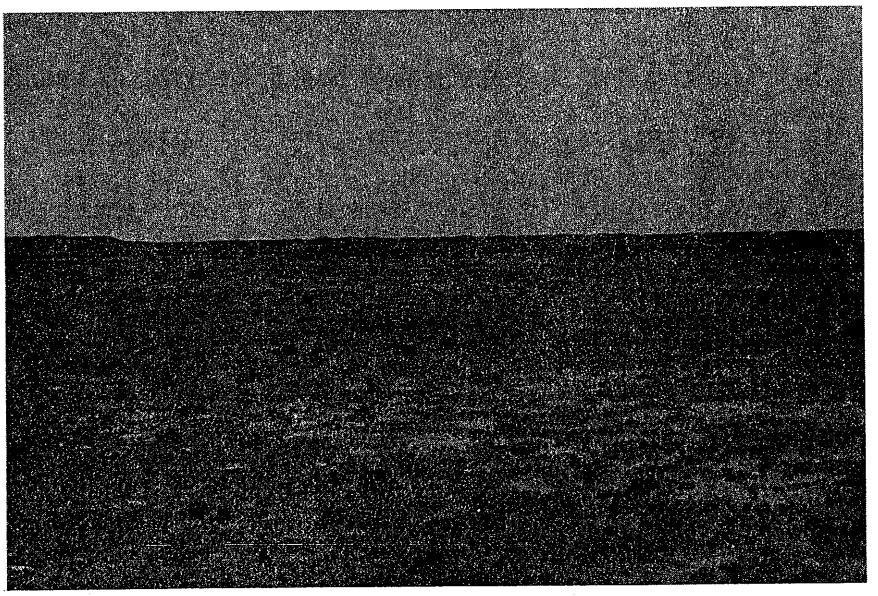

Fig. 7 Booming ground No. 2 (Mesquite-shortgrass habitat).

became fairly stable for the remainder of the courtship period. During the later portion of the courtship period, several grounds were found which had not been occupied earlier (Table 4). It is hypothesized that males which were unable to establish territories on the more heavily used booming grounds left those grounds (thereby reducing numbers on them) and established new booming grounds. One of the back-tagged males was known to move from a heavily used booming ground where he occupied a peripheral position to a new ground approximately 1 km away. The new grounds usually were on atypical sites, sometimes in sandy areas with tall grasses and shinnery oak surrounding and interspersed throughout the site. Few females were observed on these new, apparently less desirable grounds.

No clear preference for elevated sites was found during our work as the chickens could exercise no preference for elevation when using existing oil pads, and booming grounds on natural sites were found in both high and low areas.

During the first visit to the study area, on 17 February, 1976, 60 lesser prairie chickens were sighted on a total of 5 booming grounds. Of these, 57 were males and 3 were females. The males were booming and displaying. February 17 was a warm, calm day and the weather probably was responsible for this activity occurring so early in the season. During the remainder of February and in early March, males visited the booming grounds each morning, but the amount of display and booming behavior seemed to vary with temperature and wind conditions. On cold and/or windy days, the males often huddled about the edges of the ground, whereas on warmer, calm

days they displayed and boomed. As March progressed, the males became more persistent in their display and booming behavior, stayed on the grounds longer, and displayed more actively in even the most adverse weather. From approximately 15 March to late May, males were on the booming grounds in the evenings also.

On 18 March, a female was seen on booming ground No. 1. This was the first female sighted on any ground since 17 February. After that date, sightings increased rapidly with females being seen on all grounds almost every day. Many times, several females were seen on a ground at once. The largest number of females seen on a ground at once was 9. This number was seen on booming ground No. 6 on the morning of 14 April.

The peak of breeding activity was from about 28 March to 20 April. During this period, booming activity was most intense, and many females were on the grounds. The first copulation observed was on 11 April, and several more were observed during the following week. Female visitation to the booming grounds declined sharply after 20 April as the females apparently began nesting. An occasional female was sighted until about 1 June, but no breeding activity was observed after 20 April.

Booming activity decreased sharply as the number of female visits to the booming grounds decreased. The males still visited the grounds morning and evening, but display and booming behavior became more limited as time passed and female visits became increasingly less common. No booming behavior was observed after June 10. Males were seen on the grounds at times thereafter, but they did

not display. Their presence on the booming grounds at this time of year appears to be merely a form of social interaction rather than breeding behavior.

Spring Movements of Males

Male lesser prairie chickens moved very little during spring. Groups of 10 to 15 could be found near the booming grounds throughout the day, and many resting and roosting sites were located within 0.5 km of booming grounds throughout spring. These findings agree with those of Frary (1957) who reported also that males remained near booming grounds during spring. Only one of the 8 males marked during spring was known to have moved from one ground to another. This male moved from a ground occupied by many males to one less heavily used about 1 km away. Two of the 4 males which were back-tagged on booming ground No. 2 were observed on that ground during the fall booming period in October, indicating some fidelity to the ground.

Movements of Radio-Equipped Females

By tracking radio-equipped females during the period of late March through mid-April, it was found that females move rather long distances prior to nesting and use all subtypes of Shinnery Oak-tallgrass habitat during their daily activities. Although locations were not recorded for each female every day, movements of 2-3 km in a period of 2-3 days were common. Two nests and 1 nest site, which was abandoned before completion of the nest, were

located by following the radio-equipped females. Movements of one female and her brood were monitored for several days before contact was lost due to battery failure in the transmitter. Of the 3 nest sites found by tracking radio-equipped females, 1 was 2.4 km from place of capture and the other 2 were 2.6 km from place of capture. Copulation by these birds was not observed, and may have occurred on a booming ground other than the one where they were captured. Figs. 8-15 show movements of radio-tracked females.

Nesting Habitat

Bent (1932) quotes Walter Colvin's descriptions of 3 lesser prairie chicken nests found in southwestern Kansas. Two of these nests were well concealed in sand sagebrush clumps, and 1 was found under a tumbleweed which had lodged between 2 tufts of grass. Copelin (1963) reported 7 nests found in Oklahoma. All were located between clumps of grass, usually little bluestem. Jones (1963) located 1 old nest in a half-shrub, shortgrass community, but did not report the cover at the nest itself. Donaldson (1969) reported 1 nest found in Oklahoma. This nest was surrounded by little bluestem and scribner's panicum (*Panicum scribnerianum*) near ground level, and was concealed from above by brush, principally shinnery oak. Sell and Stromborg (1976) reported 4 nests located on heavily grazed range in western Texas. Cover at these nest sites consisted primarily of sand sagebrush and shinnery oak.

Descriptions of lesser prairie chicken nest sites in New Mexico have been rather general, and writers of these descriptions

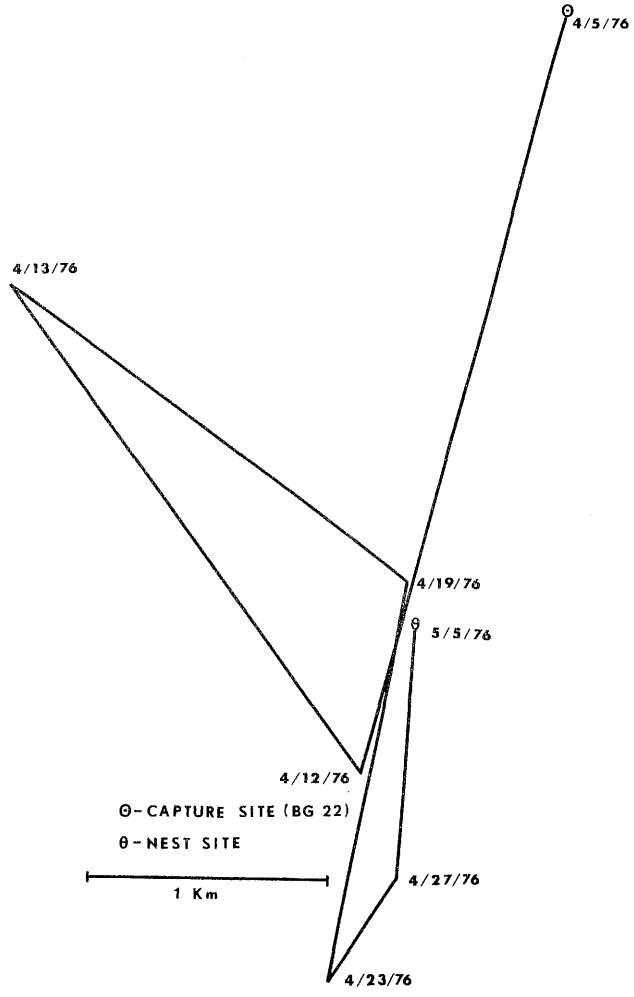

Fig. 8 Movements of Hen No. 1.

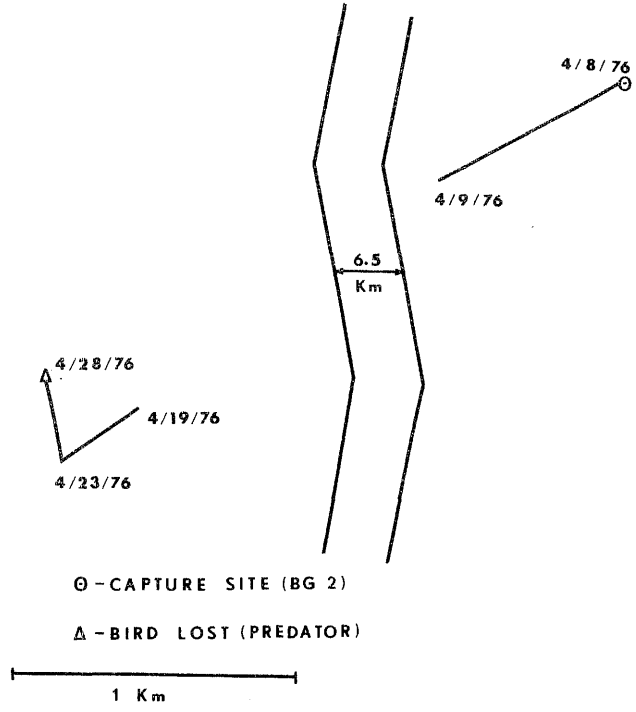

Fig. 9 Movements of Hen No. 2.

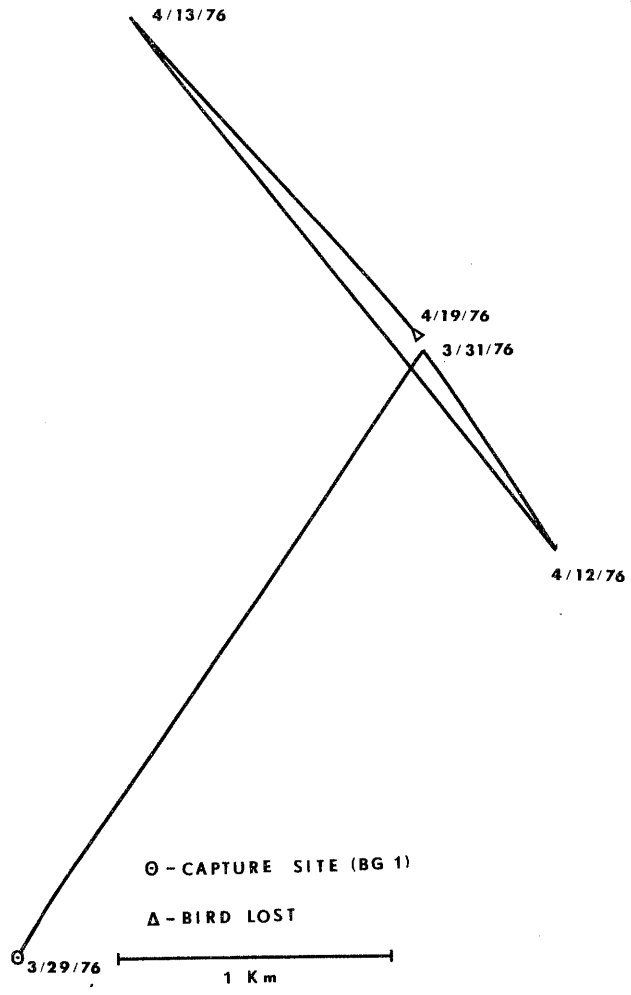

Fig. 10 Movements of Hen No. 3.

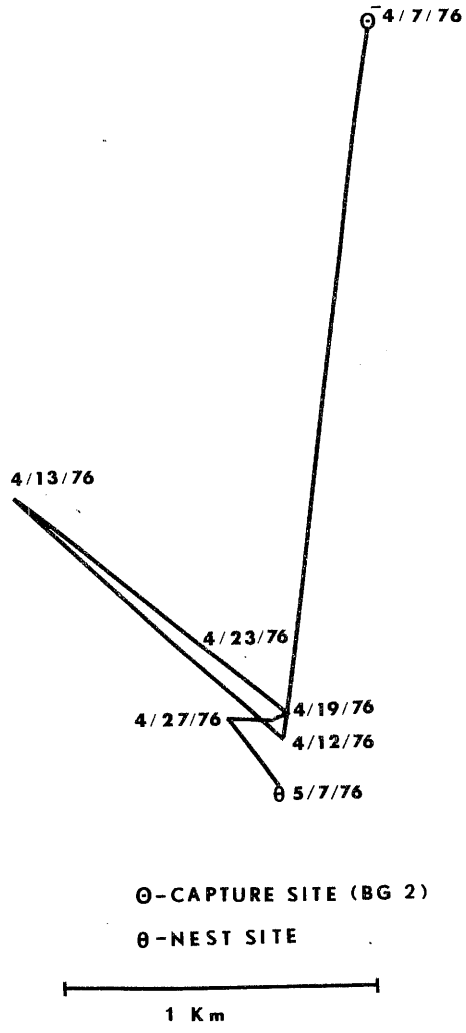

Fig. 11 Movements of Hen No. 4.

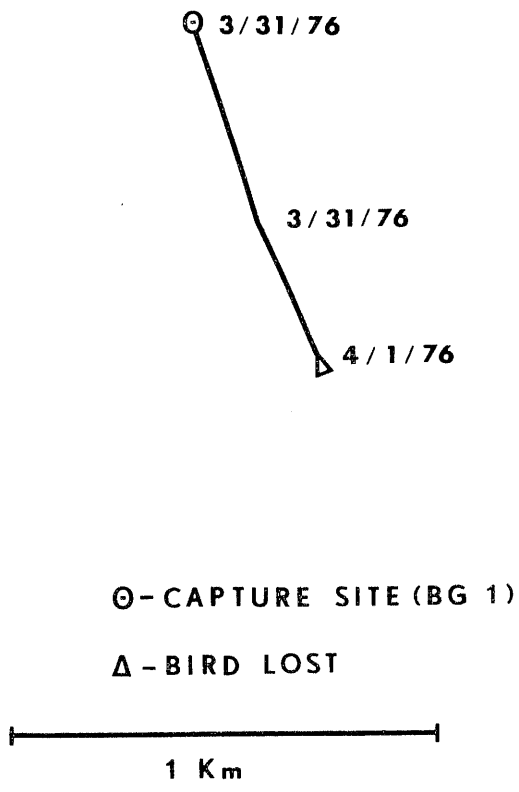

Fig. 12 Movements of Hen No. 5.

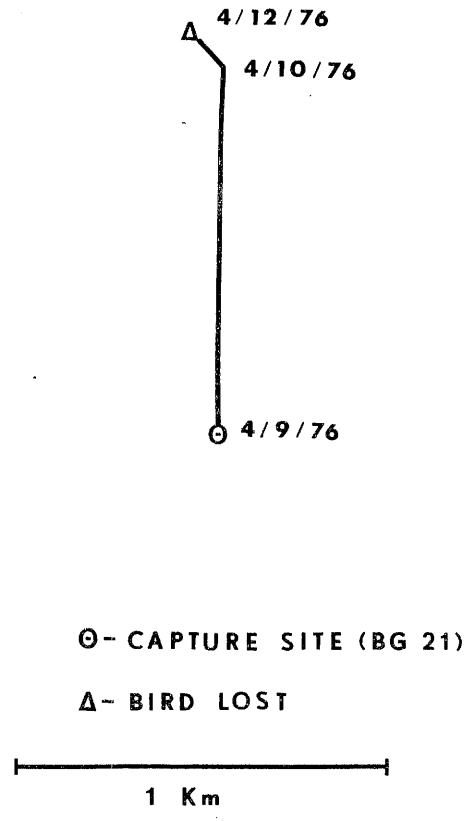

Fig. 13 Movements of Hen No. 6.

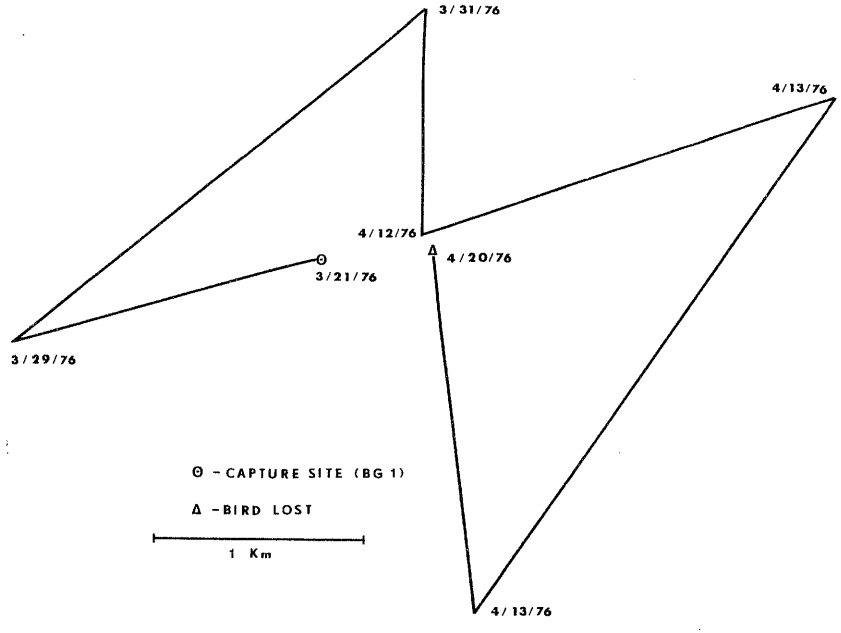

Fig. 14 Movements of Hen No. 7.

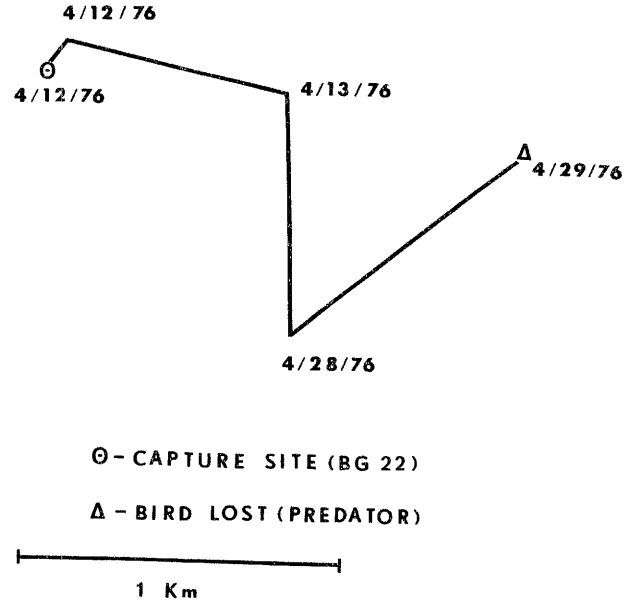

Fig. 15 Movements of Hen No. 8.

have given no indication of numbers of nest sites examined. Bailey (1928:208) states simply that the nest is ". . .in the open or among grass or weeds. . .", and Ligon (1961:92) that it is ". . .well concealed beneath rank grass or shrub, such as shinnery oak."

Six nest sites were found in the study area in 1976. Five of these were placed within or against the base of a clump of bunchgrass (Table 5), and all 6 were lined with grass and some oak leaves. Four of the nest sites were located in Subtype 1 of Shinnery Oak-tallgrass, the most grassy habitat in the study area, suggesting that this subtype represents prime nesting habitat. Basal composition of vegetation within 30 feet and within 100 steps (Tables 5, 6, 7) further illustrates the grassland aspect of the nest sites. The outstanding exception was nest site 7, and this site was abandoned soon after being discovered. Nesting habitat is shown in Figs. 16, 17, 18 and 19.

In accord with Copelin's (1963) findings for western Oklahoma, grass cover in nesting areas and at specific nest sites was provided by growth from previous years. This was due to nests being built in April and May, before any substantial amount of new growth of grasses occurred. This dependence on previous years' growth for nesting sites strongly suggests the need for maintaining areas subjected to little or no grazing for use as nesting habitat. This need is emphasized further by the fact that the cover, grass in 5 of 6 instances, under which nests were placed was taller on the average than was other nearby vegetation (Table 5).

Height and livestock utilization of 3 important kinds of

Table 5. Nest sites of six lesser prairie chickens.

Number	Nest Placement	Subtype of Shinnery Oak-Tallgrass	Basal Composition of Vegetation: Within 30 ft. of Nest[3] (Percent)	Basal Composition of Vegetation: Within 100 Steps of Nest[4] (Percent)	Height of Vegetation above Nest (CM)	Average Height of Vegetation[5] (CM)	Percent Ground Cover[3]	Percent Canopy Cover[3]
1A	Under low yucca	1	Grasses: 61 Shrubs: 39	Grasses: 60 Shrubs: 40	50	35	Plant: 14 Litter: 48 Bare: 38	49
1	In three awn clump	3	Grasses: 55 Shrubs: 45	Grasses: 59 Shrubs: 38 Forbs: 3	48	17	Plant: 9 Litter: 28 Bare: 63	49
4	Against little bluestem clump	1	Grasses: 66 Shrubs: 34	Grasses: 58 Shrubs: 39 Forbs: 3	100	29	Plant: 16 Litter: 46 Bare: 38	46
5	Under large clumps of sand bluestem and little bluestem	1	Grasses: 55 Shrubs: 43 Forbs: 2	Grasses: 53 Shrubs: 45 Forbs: 2	125	80	Plant: 17 Litter: 53 Bare: 30	58
7[1]	In little bluestem clump	3	Grasses: 35 Shrubs: 65	Grasses: 48 Shrubs: 52	138	29	Plant: 8 Litter: 38 Bare: 54	31
8[2]	Against sand bluestem clump	1	Grasses: 73 Shrubs: 24 Forbs: 3	Grasses: 60 Shrubs: 28 Forbs: 12	27	39	Plant: 28 Litter: 32 Bare: 40	30
					$\bar{X}$ = 81.3	$\bar{X}$ = 38.2	$\bar{X}$ = Plant: 15.4 Bare: 40.8 Litter: 43.8	$\bar{X}$ = 43.8

See Footnotes, next page.

Table 5 (Cont'd.)

[1]Abandoned before egg-laying.

[2]Nest found in November, 1976.

[3]Determined from eight 30-foot line transects radiating from each site and having points at one-foot intervals (240 points per site).

[4]Determined from four line transects radiating from each site, with points at two-step intervals.

[5]Determined from 80 height measurements per site.

Table 6. Percent basal composition of vegetation within 30 feet of six nests of lesser prairie chickens.[1]

	Nest 1A	Nest 1	Nest 4	Nest 5	Nest 7[2]	Nest 8
Three-awns	15.4	22.9	13.3	5.0	16.3	5.0
Dropseeds	2.1	4.6	1.7	7.1	-	10.0
Sand bluestem	24.2	7.9	20.0	25.8	10.0	48.8
Little bluestem	5.4	4.6	15.8	4.1	2.4	6.2
Hairy grama	3.8	10.4	9.6	7.1	6.3	-
Sand lovegrass	2.1	1.2	1.3	1.3	-	1.2
Hall's panicum	8.3	3.8	4.6	4.6	-	2.5
Total Grass	61.3	55.4	66.3	55.0	35.0	73.7
Shinnery oak	35.4	43.3	32.9	41.7	65.0	23.8
Yucca	2.5	1.3	0.4	1.3	-	-
Prickly pear	0.4	-	-	-	-	-
Sand sagebrush	0.4	-	0.4	0.4	-	-
Total Shrubs	38.7	44.6	33.7	43.4	65.0	23.8
Annual forbs	-	-	-	1.6	-	2.5
Total Forbs	-	-	-	1.6	-	2.5

[1]Determined from eight line transects radiating from each nest and having points at one-foot intervals (240 points per site).

[2]Abandoned before egg-laying.

Table 7. Percent basal composition of vegetation within 100 steps of six nests of lesser prairie chickens.[1]

	Nest 1A	Nest 1	Nest 4	Nest 5	Nest 7[2]	Nest 8
Three-awns	8.5	16.0	5.5	10.5	24.5	6.5
Dropseeds	4.5	8.5	11.5	6.0	4.0	5.5
Sand bluestem	28.5	12.0	22.5	22.0	4.0	27.0
Little bluestem	4.0	7.5	5.5	3.5	4.5	6.0
Hairy grama	6.5	11.0	7.0	7.0	8.5	6.0
Sand lovegrass	1.0	1.0	2.0	-	1.0	-
Hall's panicum	7.5	3.0	4.0	4.0	1.5	5.5
Scribner's panicum	-	-	0.5	-	-	-
Paspalum	-	-	-	-	-	2.0
False buffalograss	-	-	-	-	-	1.5
Total Grass	60.5	59.0	58.5	53.0	48.0	60.0
Shinnery oak	38.0	38.0	38.0	43.5	51.0	27.0
Sand sagebrush	1.0	-	0.5	1.0	-	-
Yucca	0.5	-	-	0.5	0.5	1.5
Prickly pear	-	-	0.5	1.0	0.5	-
Total Shrubs	39.5	38.0	39.0	46.0	52.0	28.5
Buckwheat	-	3.0	-	-	-	-
Annual forbs	-	-	2.5	1.0	-	11.5
Total Forbs	-	3.0	2.5	1.0	-	11.5

[1]Determined from four line transects radiating from each nest and having points at two-step intervals (200 points per nest area).

[2]Abandoned before egg-laying.

Fig. 16 Subtype 1 of Shinnery Oak-tallgrass (prime nesting habitat).

Fig. 17 Nest site No. 4 (Subtype 1).

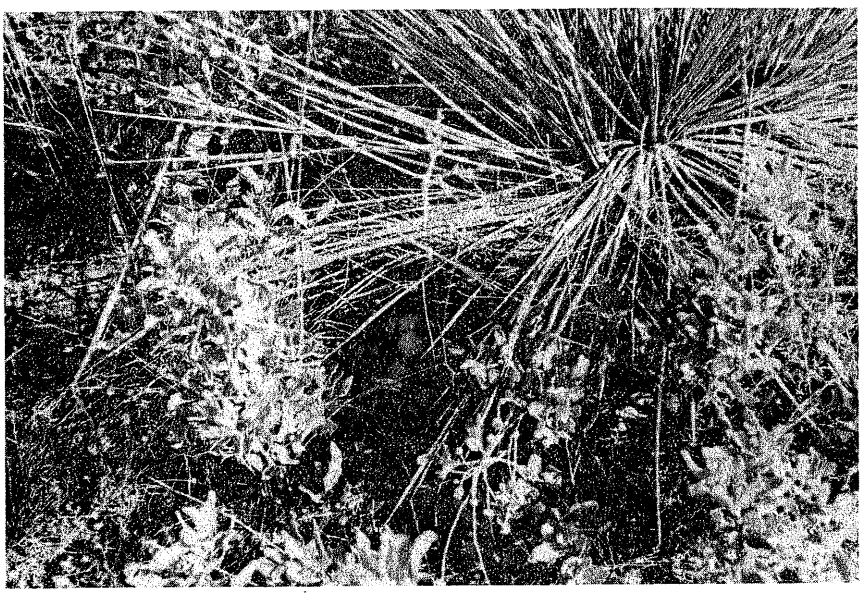

Fig. 18 Nest site No. 1A (Subtype 1).

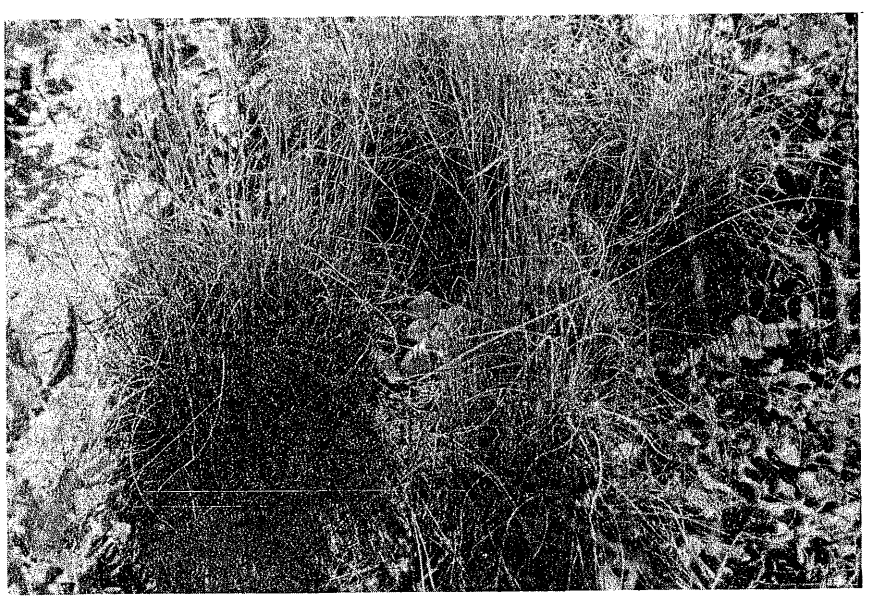

Fig. 19 Nest site No. 1 (Subtype 3).

grasses within 30 feet of 5 of 6 nest sites are summarized in Table 8. Nest sites No. 1A, No. 4, and No. 5 were in areas subjected to little or no grazing. Heights of individual plants near these nests generally were in the 80-100 cm class, and utilization was correspondingly low at all these sites. Nest site No. 7 (Subtype 3), which was abandoned early in the season, had shorter height averages and greater utilization estimates. This may have been part of the reason for abandonment. However, it must be noted that nest No. 3 (also in Subtype 3) was successful despite being in an area dominated by short, heavily grazed grass.

Brood Habitat

During June and early July, broods were more abundant along sand ridges in Subtypes 3 and 4 of Shinnery Oak-tallgrass (Avg. 0.33 brood sign/hr/km^2 for 3 and 4 combined), where grasses and total ground cover were relatively sparse, than in Subtypes 1 and 2 (Avg. 0.01 brood sign/hr/km^2 for 1 and 2 combined) which appeared to be prime nesting habitat (Table 9).

Movements of 1 radio-equipped female and her brood were followed for a period of 9 days after hatching until the transmitter stopped functioning. The brood moved approximately 0.75 km on the night of the hatch, indicating high mobility of very young chicks. During the following week, daily movements were short, usually not more than 200-300 m (Fig. 20). This brood remained in an area of Subtype 3 throughout the tracking period, and utilized the more brushy areas resembling the Subtype 4 condition. Jones (1963)

Table 8. Height and utilization of three kinds of grasses within 30 feet of prairie chicken nest sites.[1]

Nest Number	Average Height (cm)			Average Percent Utilization		
	Sand Bluestem	Little Bluestem	Dropseeds	Sand Bluestem	Little Bluestem	Drop-Seeds
1	101.3	88.5	50.4	9.6	12.0	0.3
1A	22.8	60.4	24.2	75.9	49.6	5.9
4	89.4	84.8	53.9	0	0	0
5	78.5	78.9	56.7	18.4	13.3	0.5
7	32.3	53.1	16.6	47.5	31.3	3.3
Average	64.9	73.1	41.6	30.3	21.2	2.0

[1]Determined from eight 30-foot line transects radiating from each nest.

Table 9. Indices to brood use in sample areas.

Area	Extent (km^2)	Habitat Type And Subtype	Brood Obs./ Hr./ km^2
1	0.65	S-t* 1	0
2	3.90	S-t* 1, 2	0.03
3	2.60	S-t* 4	0.28
4	0.65	S-t* 4	1.03
5	1.95	S-t* 4; M-s**	0.13
6	1.95	S-t* 1	0
7	1.30	S-t* 4	0
8	1.30	S-t* 3, 4	0.51
9	2.60	S-t* 3	0.77
10	2.60	S-t* 3, 4	0.34
11	2.60	S-t* 3	0.19
12	2.60	S-t* 3	0.26
13	1.95	S-t* 3	0.51
14	3.12	S-t* 3	0
15***	3.64	S-t* 1, 3	0
16***	1.95	S-t* 2, 3; M-s**	0
17	3.25	M-s**	0
18	3.25	S-t* 4	0.15
19	1.30	M-s**	0
20	1.95	S-t* 3	0.51

*Shinnery oak - tallgrass.

**Mesquite - shortgrass.

***Data unused because of mixing of tallgrass and brushy habitats.

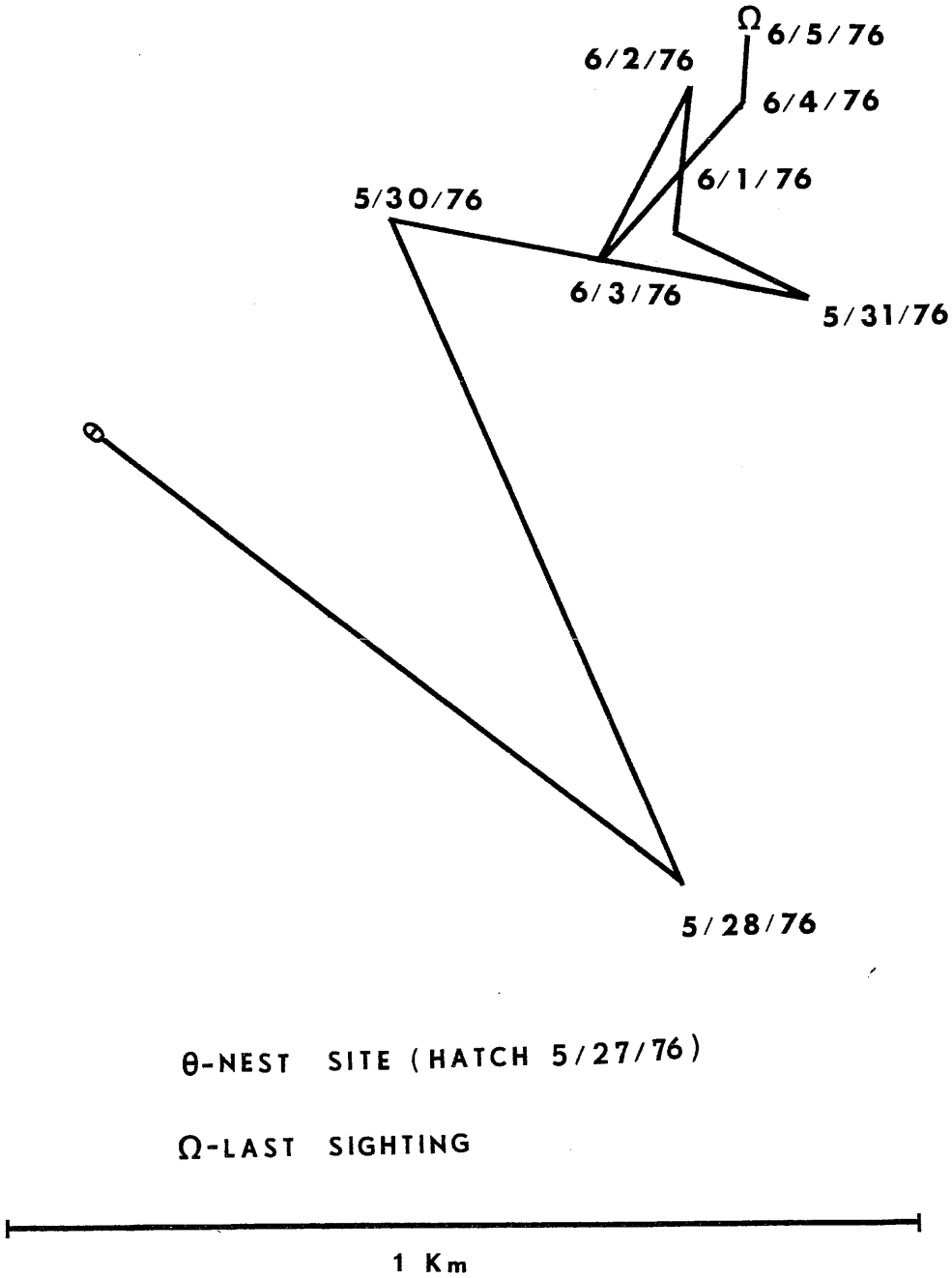

Fig. 20 Movements of Hen No. 1 with brood.

found that lesser prairie chicken broods in Oklahoma preferred areas dominated by shrub and half-shrub life forms with relatively large percentages of forbs, which is in agreement with our findings of heavy brood use in Subtypes 3 and 4.

Vegetation was sampled at specific brood foraging sites found scattered within the areas of heavy use. These foraging sites were identified by patterns of tracks, scratching, and clipped plants found at the specific sites. Data (Table 10) were quite similar to those taken randomly from Subtype 4 (Table 3), and are in agreement with those of Donaldson (1969), who found that broods utilized vegetation which was low in stature and of rather open aspect for feeding activities.

Vegetation in brood areas (Table 11) averaged considerably shorter and provided less plant cover than that near nests (Table 5). These differences probably were due to vegetation in brood areas being more shrubby, and correspondingly less grassy, than that near nests. At this time it appears that prime brooding habitat may be distinguished from prime nesting habitat by field inspection. The greater brushiness of most brood areas is due to greater abundance of shinnery oak, a phenomenon which often is readily visible.

In July brood sign became increasingly scarce in Subtype 4, and more was found in Subtypes 2 and 3 in areas more heavily dominated by tall grasses. It is not known if this represents a predictable seasonal shift in habitat use. A shift in the young birds' diet from small insects to large grasshoppers was noted during this period, and this change in food preference may have been part of the

Table 10. Percent basal composition of vegetation at 29 brood foraging sites.[1]

Three-awns		21.0 ± 3.8[2]
Sand bluestem		1.8
Little bluestem		3.2
Dropseeds		3.2
Hairy grama		6.4
Hall's panicum		6.8
Sand lovegrass		0.6
False buffalograss		1.4
Scribner's panicum		0.3
	Total Grasses	44.7 ± 7.3
Shinnery oak		45.9 ± 7.5
Sand sagebrush		1.0
Trace species[3]		0.4
	Total Shrubs	47.3 ± 7.5
Western ragweed		1.5
Flax		1.8
Hymenopappus		0.5
Trace species[3]		0.7
Unknown forbs		3.5
	Total Forbs	8.0 ± 2.9

[1] Determined from eight line transects radiating from center of each site and having points at one foot intervals (80 points per site).

[2] Confidence interval ($\rho<0.05$)

[3] Species composing less than 0.50% each of total composition.

Table 11. Height, ground cover, and canopy cover of vegetation at 29 brood foraging sites.[1]

Height	
Average center height[2]	22.4cm ± 5.3[4]
Average overall height[3]	18.4cm ± 2.5
Percent Ground Cover	
Plant	8.6 ± 1.5
Litter	40.4 ± 6.0
Bare	51.0 ± 7.3
Percent Canopy Cover	47.7 ± 6.3

[1]Determined from eight 10-foot line transects radiating from each site and having points at one-foot intervals (80 points per site).

[2]One height measurement taken at center of each site.

[3]Twenty-five height measurements per site.

[4]Confidence interval ($\rho<0.05$)

reason for the shift, as grasshoppers seemed more abundant in the more grassy areas.

Habitat Use by Adults: March through May

Daytime Resting Sites

Jones (1963) found that lesser prairie chickens in Oklahoma used mostly shrub and half-shrub areas for daytime resting. This observation held true for birds in this study area, as they selected areas for resting where shrubs (especially shinnery oak) accounted for more than 80 percent of the actual cover present (Table 12) and 56 percent of the basal composition of vegetation (Table 13). These findings indicate a decided preference for shrubby cover since Subtype 4, which has the largest amount of shrubs, has only 46 percent of its basal composition represented by shrubs. Height of vegetation at specific use sites was considerably taller than the average height of vegetation in the surrounding areas (Table 14).

Resting sites (Tables 12, 13, and 14), which were recognized by accumulations of droppings, were located throughout the study area in several cover types. As spring progressed and weather became warmer, there was a shift of resting sites from open canopy that allowed the birds to sun, to sites that were under grass or brush canopy which provided shade. Frary (1957), Jackson and DeArment (1963), and Copelin (1963) also found lesser prairie chickens using dense, brushy cover for resting sites during summer.

Table 12. Percent canopy composition of cover species at 28 adult resting sites.[1]

Three-awns		12.0
Little bluestem		1.6
Sand lovegrass		0.6
Trace species[2]		1.1
	Total Grass	15.3
Shinnery oak		75.7
Yucca		7.0
Sand sagebrush		0.7
	Total Shrubs	83.4
Trace species (Forbs)		1.3
	Total Forbs	1.3

[1]Determined from eight 10-foot line transects radiating from the center of each site and having points at one-foot intervals (80 points per site).

[2]Species composing less than 0.5% each of total composition.

Table 13. Percent basal composition of vegetation at 28 adult resting sites.[1]

Three-awns		22.5
Sand lovegrass		2.2
Hairy grama		3.1
Little bluestem		2.2
Dropseeds		1.4
Hall's panicum		2.7
Sand bluestem		0.9
	Total Grasses	35.0
Shinnery oak		54.7
Yucca		1.1
Sand sagebrush		0.2
	Total Shrubs	56.0
Western ragweed		0.6
Trace species[2]		2.2
Unknown forbs		6.2
	Total Forbs	9.0

[1]Determined from eight 10-foot line transects radiating from center of each site and having points at one-foot intervals (80 points per site).

[2]Species composing less than 0.5% each of total composition.

Table 14. Height, ground cover, and canopy cover of vegetation at 28 adult resting sites.[1]

Height	
Average center height[2]	35.0 cm
Average overall height[3]	20.6 cm
Percent Ground Cover	
Plant	7.5
Litter	28.0
Bare	64.5
Percent Canopy Cover	49.2

[1]Determined from eight 10-foot line transects radiating from each site and having points at one-foot intervals (80 points per site).

[2]One height measurement taken at center of each site.

[3]Twenty-five height measurements per site.

Night Roosting Sites

Copelin (1963) found roosting sites of lesser prairie chickens in grassed ravines, draws, and on ridges. Moderately grazed pastures were used more often than heavily grazed ones, and roost sites were not found with overhead cover more than 1 m high. Jones (1963) described night roosts of lesser prairie chickens more specifically, noting that they were found in pockets of short vegetation within areas of taller vegetation.

Data were collected from 27 adult roosting sites, indicated by droppings, found throughout the study area (Tables 15, 16). Most roost sites found were in moderately grazed pastures (Subtypes 3 and 4) and basal composition data were similar to those for Subtype 4. Roost sites generally were small, sandy openings in the vegetation and, with one exception, all sites were open overhead. It was found, in agreement with Frary (1957), that during spring, males often roosted near booming grounds, with some roosting on the booming ground itself or around its edges.

Foraging Sites

Data were collected from 9 adult foraging sites identified by patterns of tracks and clipped plants. These data (Tables 17, 18) need supplementation before definite conclusions about this type of use site can be reached, but the close similarities between adult and brood foraging sites (Tables 12, 13) are noteworthy. A relatively high percentage of forbs (10.4 percent) is present at these sites.

Table 15. Height, ground cover, and canopy cover of vegetation at 28 adult resting sites.[1]

Height	
Average center height[2]	37.9 cm.
Average overall height[3]	24.0 cm.
Percent Ground Cover	
Plant	9.6
Litter	35.4
Bare	55.0
Percent Canopy Cover	49.3

[1]Determined from eight 10-foot line transects radiating from each site and having points at one-foot intervals (80 points per site).

[2]One height measurement taken at center of each site.

[3]Twenty-five height measurements per site.

Table 16. Percent basal composition of vegetation at 27 adult roosting sites.[1]

Three-awns		20.6
Hairy grama		3.7
Hall's panicum		4.1
Little bluestem		1.6
Dropseeds		2.3
Sand bluestem		5.4
Sand lovegrass		0.7
	Total Grasses	38.4
Shinnery oak		50.7
Yucca		1.2
Trace species[2]		0.4
	Total Shrubs	52.3
Western ragweed		1.4
Cryptantha		0.6
Trace species[2]		1.3
Unidentified forbs		6.0
	Total Forbs	9.3

[1]Determined from eight 10-foot line transects radiating from center of each site and having points at one-foot intervals (80 points per site).

[2]Species composing less than 0.5% each of total composition.

Table 17. Height, ground cover and canopy cover of vegetation at 9 adult foraging sites.[1]

Height	
Average center height[2]	25.0 cm
Average overall height[3]	21.3 cm
Percent Ground Cover	
Plant	12.2
Litter	29.9
Bare	57.9
Percent Canopy Cover	43.3

[1]Determined from eight 10-foot line transects radiating from each site and having points at one-foot intervals (80 points per site).

[2]One height measurement taken at center of each site.

[3]Twenty-five height measurements per site.

Table 18. Percent basal composition of vegetation at 9 adult foraging sites.[1]

Three-awns		24.7
Hairy grama		4.7
Little bluestem		3.9
Sand lovegrass		3.2
Dropseeds		1.5
Sand bluestem		0.6
Hall's panicum		3.2
	Total Grasses	41.8
Shinnery oak		46.5
Yucca		1.0
Trace species[2]		0.3
	Total Shrubs	47.8
Buckwheat		2.2
Hymenopappus		0.6
Flax		1.1
Cryptantha		0.7
Trace species[2]		0.4
Unknown forbs		5.4
	Total Forbs	10.4

[1]Determined from eight 10-foot line transects radiating from center of each site and having points at one-foot intervals (80 points per site).

[2]Species composing less than 0.5% each of total composition.

Use of Habitat Types

A summary of all adult use sites (resting, roosting, foraging) during the period March through May shows that 67.2 percent of all habitat use occurred in Subtype 3 of Shinnery Oak-tallgrass, indicating considerable importance of this subtype to adult prairie chickens. The large amount of use in Subtype 3 is in contrast with 6.2 percent use in Subtype 1, 3.1 percent use in Subtype 2, 21.9 percent use in Subtype 4, and 1.6 percent use in Mesquite-shortgrass.

Habitat Use by Adults: October through January

During October 1976, through January 1977, monthly trips were made to the study area. Eight census routes, totalling 78 km, were established on north-south axes across the study area, at 1.1 km intervals, dissecting all types and subtypes. Observers walked these census routes monthly and recorded birds flushed and the type and subtype of habitat they were flushed from. The birds frequented Subtype 3 of Shinnery Oak-tallgrass habitat to a far greater extent than any other subtype, with 81.5 percent of the sightings being made in Subtype 3 (Table 19). The heavy use of Subtype 3 may have resulted from shinnery oak, an important food, being quite abundant in this subtype. This food source, in conjunction with more cover than is present in Subtype 4, may have attracted the adult chickens to this type of area.

Booming ground activity during fall also was monitored. It was reported by BLM field personnel that birds of both sexes were

Table 19. Habitat use by lesser prairie chickens during fall and winter months.[1]

Dates	Shinnery Oak - Tall Grass				Mesquite Short Grass
	Subtype 1	Subtype 2	Subtype 3	Subtype 4	
22-24 Oct.	-	3	28	13	-
19-21 Nov.	-	-	14	-	-
20-22 Dec.	-	1	12	-	-
10-12 Jan.	-	-	21	-	-
Totals	0	4	75	13	0

[1]Sightings made on permanent walking census routes, totalling 78 km, established throughout the study area.

on the booming grounds during September, and that males were displaying. During field work in October, substantial numbers of birds were found on several of the major booming grounds, but booming activity was limited. On subsequent trips to the area during November, December, and January, no birds were seen on the booming grounds. The grounds and their immediate surroundings were inspected each month for tracks, droppings, and other indications of use, but no sign of activity was found.

Although the birds abruptly stopped frequenting the booming grounds in October, and some reduction in numbers seen on census routes occurred during November through January (Table 19), it is not believed that large numbers of birds dispersed from the study area. Variations in numbers of birds seen while walking the census routes probably were due to other factors such as weather conditions, predation, and collection of 9 birds during October through January for the food habits study.

Food Habits

Foods of adult lesser prairie chickens during March through May (Table 20) were primarily vegetative material (60.4 percent) and mast and seeds (27.5 percent). Shinnery oak parts were extremely important, as they made up 84.4 percent of the total diet. Insects were used only in small amounts, perhaps due to low availability. Frary (1957) also found vegetable matter to be important during late winter and spring, composing 96 percent of total foods in his study during this period.

Table 20. Spring food items of adult lesser prairie chickens.[1]

Food Item	Average Percent Composition	Range
Mast and Seeds		
Acorns	26.8	0-75.3
Unclassified	0.7	0-4.7
Total	27.5	
Vegetative Material		
Oak catkins	53.2	0-100.0
Oak leaves	3.6	0-13.3
Oak buds	0.8	0-6.8
Downy phlox	0.9	0-5.6
Ratany	1.9	0-16.7
Composite flowers	t[2]	0-t[2]
Grass	t[2]	0-t[2]
Unclassified	t[2]	0-t[2]
Total	60.4	
Insects		
Ants	t[2]	0-t[2]
Treehoppers	8.5	0-77.8
Scarab beetles	3.2	0-28.6
Unclassified	0.4	0-3.5
Total	12.1	

[1]Determined from crop contents of nine birds collected from March through May, 1976.

[2]Trace

Crops and gizzards of young chicks (approximately 2-4 weeks of age) contained several types of small insects and no vegetation at all (Table 21). Small treehoppers and grasshoppers composed more than 80 percent of the diet. This exclusive diet of insects no doubt relates to young birds' well-known need for protein during this period of rapid growth and development. Insects continued to be very important as the young birds grew (Table 22). At the approximate age of 6-10 weeks, they began eating small acorns and some vegetation, but insects still composed 98.7 percent of the diet. It was found that the size of insects eaten increased as the birds became larger. Young birds foraged primarily in areas of rather open aspect in Subtypes 3 and 4 (Table 9). This type of area probably allowed freer movement of the small birds and enhanced maneuverability in capturing insects.

Although Frary (1957) found 71 percent insect material in his small sample of crops collected during fall, findings of this study compare much more closely with those of Crawford (1974) who found that 81 percent of the diet of lesser prairie chickens during fall was vegetable matter. In our study, seeds and vegetative material were very important during late summer and fall for adult birds and for young birds that had reached adult size (Table 23). Shinnery oak acorns accounted for 67.0 percent of the diet, and plant material composed 82.6 percent of the total diet.

Jones (1963) pointed out the importance of insects to lesser prairie chickens, and this importance is shown by our study. Insects are, of course, of critical importance to young birds, but they also

Table 21. Food items of young lesser prairie chickens (2-4 weeks of age).[1]

Food Item	Average Percent Composition	Range
Insects		
Treehoppers	65.2	0-85.7
Short-horned grasshoppers	18.6	0-40.0
Ants	11.2	0-25.0
Mantids	t[2]	0-t
Snout beetles	5.0	0-20.0
Unclassified	t	0-t
Total	100.0	

[1]Determined from three crops and two gizzards from birds collected during June, 1976.

[2]Trace.

Table 22. Food items of young lesser prairie chickens (6-10 weeks of age).[1]

Food Item	Average Percent Composition	Range
Mast and Seeds		
Acorns	1.3	0-9.4
Vegetative Material		
Downy phlox	t[2]	0-t
Insects		
Short-horned grasshoppers	73.9	40.0-100.0
Crickets	1.7	0-11.8
Darkling beetles	t	0-t
Mantids	5.4	0-14.0
Robber flies	0.9	0-6.2
Ants	t	0-t
Mining bees	t	0-t
Click beetles	0.9	0-4.6
Treehoppers	1.5	0-9.1
Long-horned grasshoppers	7.3	0-27.3
Snout beetles	5.9	0-40.0
Unclassified	1.2	0-4.6
Total	98.7	

[1]Determined from six crops and one gizzard from birds collected during July and August, 1976.

[2]Trace.

Table 23. Summer and fall food items of lesser prairie chickens (approximately 20 weeks of age and older).[1]

Food Item	Average Percent Composition	Range
Mast and Seeds		
Acorns	67.0	0-97.4
Spurge	3.3	0-14.9
Unclassified	0.4	0-3.8
Total	70.7	
Vegetative Material		
Erect dayflower	1.6	0-12.3
Downy phlox	2.8	0-18.2
Oak leaves	0.9	0-9.1
Dwarf dalea	4.4	0-45.4
Spurge leaves	2.2	0-22.0
Unclassified	t[2]	0-t
Total	11.9	
Insects		
Mantids	1.3	0-15.0
Stink bugs	0.4	0-4.6
Darkling beetles	0.7	0-4.6
Ants	t	0-t
Short-horned grasshoppers	1.3	0-12.2
Crickets	2.2	0-18.9
Butterfly larvae	1.4	0-17.0
Treehoppers	t	0-t
Spiders	t	0-t
Insect galls	10.1	0-74.7
Unclassified	t	0-t
Total	17.4	

[1]Determined from crops of 12 birds collected August through December, 1976.

[2]Trace.

are important to adult birds, as they composed 12.1 percent of the diet during spring and 17.4 percent of the diet during late summer and fall.

Summary and Interpretation

Vegetation in the study area consists of two principal types, Shinnery Oak-tallgrass and Mesquite-shortgrass. Shinnery Oak-tallgrass includes 4 subtypes, with Subtype 1 having the greatest amount of grass, Subtype 2 the second greatest, etc.

Lesser prairie chickens preferred Mesquite-shortgrass and man-caused open areas (roads, oil pads) for booming grounds. Females appeared to prefer Subtype 1 of Shinnery Oak-tallgrass and probably also would use Subtype 2 freely for nesting habitat. Habitat used for other purposes was more brushy and correspondingly less grassy: preferred brood-rearing habitat was in Subtypes 3 and 4, and preferred adult habitat appeared to be in Subtype 3.

The center portion of the study area (Fig. 5) appears to be in relatively good condition for prairie chickens. Areas of both types (Shinnery Oak-tallgrass and Mesquite-shortgrass) and all four subtypes of Shinnery Oak-tallgrass are interspersed in close proximity to each other, so that yearlong habitat needs are available in a relatively small area. Further, the ease with which prairie chickens were found in the center of the study area suggests that numbers there were not dangerously low.

Outlying portions of the study area (Fig. 5) appear to be considerably less suitable for prairie chickens. Large areas are occupied by Subtypes 3 and 4 of Shinnery Oak-tallgrass and by

Mesquite-shortgrass, so that much potential habitat is available for broods and for non-nesting adults. However, prime nesting habitat (Subtypes 1 and 2 of Shinnery Oak-tallgrass) appears virtually absent. The fact that the study area as a whole contains more than the 6-7 percent of good nesting habitat recommended (Hamerstrom et al. 1957) as minimum for (greater) prairie chickens is meaningless so long as practically none is present in outlying parts of the area. Only 3 of the 8 females radio-tracked in this study (Figs. 8-15) made net movements as far as 4 km during their prenesting period,[2] while many outlying areas (where females might live before nesting season) are 4-6 km from prime nesting areas. Therefore, additional blocks of potential nesting habitat should be developed in various parts of the study area.

There can be little doubt that the general shortage of nesting cover in much of the study area is due, at least in part, to grazing. The largest block of good nesting cover (Subtypes 1-2 of Shinnery Oak-tallgrass) is in the eastern part of pasture E (Fig.1), in the center of the area, in which the only livestock water is near the west fence. The tendency of livestock to graze near water probably has been responsible for the eastern part of this pasture being lightly grazed and, therefore, continuing to support a vigorous stand of tallgrasses.

In pasture G (Fig. 1), both water and tall grasses occur at the same (western) end of the pasture. This situation appears, at

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[2]Defined here as the period of time from capture on a booming ground, where copulation presumably occurred, to nesting or to loss of radio contact if nesting had not occurred.

first, to contradict the explanation of grazing vs. tallgrasses given above. However, the occurrence of water and tallgrass together in this pasture is due to the pasture being more lightly grazed than its neighbors--fenceline contrasts between tallgrasses (Subtypes 1-2) in this pasture and brushy areas (Subtype 4) in the adjacent pastures on the north and south make this fact obvious. Two of these 3 pastures are somewhat more brushy toward the east. Both of these contain water developments in their eastern portions, just off the study area. The west-east change from tallgrasses to more brushy vegetation in these pastures may be due to heavier grazing toward the east or perhaps to a soil gradient toward the high plains, which rise abruptly just to the east of the study area.

Condition of vegetation in and adjacent to grazing exclosures lends still more support to the suggestion that absence of potential nesting cover (tallgrasses) in much of the area is due to grazing. For example, the Mathers Natural Area (pasture F, Fig. 1) is a 32 ha exclosure, characterized by tallgrasses, near the center of the study area. It is joined on the north, east, and west by the relatively lightly grazed pastures described above and, at these boundaries, vegetation inside the exclosure is similar to that outside. However, the south boundary of the Mathers Area provides a classic fenceline contrast. Vegetation in the adjacent pasture (pasture H, Fig. 1) is very brushy(Subtype 4), and livestock utilization of grasses is obviously heavy.

RECOMMENDATIONS

Preliminary Management Recommendations

1. Reduction of grazing pressure in the brushier pastures (Subtype 3 and, especially, Subtype 4 of Shinnery Oak-tallgrass) would improve large areas of habitat for use by lesser prairie chickens. Due to the uneven nature of livestock grazing on the range, there are small areas, within large blocks of Subtypes 3 and 4, that approach the good nesting conditions found in Subtypes 1 and 2. Reduction of grazing pressure could allow a visible recovery of overgrazed range and, especially, could allow recovery of those smaller areas within Subtypes 3 and 4 that then might serve as nesting habitat.

Subtype 3 habitat composes approximately 40-45 percent of the Shinnery Oak-tallgrass type, but receives 67 percent of total habitat use by adults in spring and 81 percent in fall and early winter. This heavy use shows a preference for Subtype 3 and strengthens the argument for a plan of reduced grazing pressure. A meaningful reduction, as opposed to token reduction, should allow heavily grazed pastures (primarily Subtype 4) to recover to some extent and approach the Subtype 3 condition which appears to be preferred adult habitat. This reduction would not, at any time soon, cause the major portions of these pastures to become exceedingly grassy and thereby lose their value as brood-rearing habitat. There will continue to be large brushy areas due to local soil and slope characteristics and to heavy grazing at water, natural gathering

sites, livestock trails, etc., and these will provide ample brood-rearing areas. Grazing reductions must be long term changes, and areas affected would need to be monitored yearly to evaluate vegetational changes.

If grazing pressure in brushy pastures is not reduced quickly, deterioration of grasslands will proceed at an accelerated speed. This is because a constant level of grazing on a declining supply of forage (mostly grasses) will only cause the quantity of grasses to decline faster and still faster as time passes.

2. Much of Subtype 1 and 2 habitat, which is considered prime nesting habitat, exists because there is no livestock water in these areas and, therefore, they receive little or no grazing. The development of new watering facilities in the study area, therefore, should be prohibited. The establishment of a watering device in any formerly ungrazed or lightly grazed area would subject that area to grazing, and it would lose its value as nesting habitat quickly. The resident population of lesser prairie chickens would suffer severely as a result of such loss.

3. Cattle exclosures should be developed in portions of the study area where nesting habitat is absent or scarce. These exclosures must be developed in areas where the grasses can be expected to make an adequate recovery to tallgrass cover within a reasonable time period. Exclosures should be established in or adjacent to areas of Subtype 3-4 habitat which have been shown by this study to be important as brood-rearing areas, and must be large enough to be found

and utilized by the birds. The Mathers Natural Area, a cattle exclosure of approximately 32 ha, is known to be utilized as nesting habitat by lesser prairie chickens. This exclosure, however, adjoins a large area of Subtypes 1 and 2, and thus produces a much larger tract of nesting habitat. Tentatively, it appears that an isolated exclosure of 32 ha might be large enough to provide nesting habitat. Further study is needed to determine whether isolated tracts of only 32 ha are, in fact, large enough.

Placement of these exclosures must be in proximity to areas of Subtype 3-4 of Shinnery Oak-tallgrass usable as brood-rearing habitat, and not necessarily other features such as booming grounds or water. Our telemetry study showed that females are somewhat mobile, moving distances of 2-3 km in a period of 1-2 days. Three radio-equipped females selected nest sites approximately 2 km from the booming grounds where they were captured. There is no place in the study area more than 3 km from the nearest booming ground, and probably there are unrecorded grounds in some areas, so placement of nesting areas with respect to booming grounds should not be a problem. Specific locations for livestock exclosures must be selected on an individual basis by the local wildlife biologist in conjunction with range management personnel in order to insure selection of sites that are compatible to the needs of lesser prairie chickens and also are capable of recovery. Some possible locations for exclosures are shown in Fig. 21.

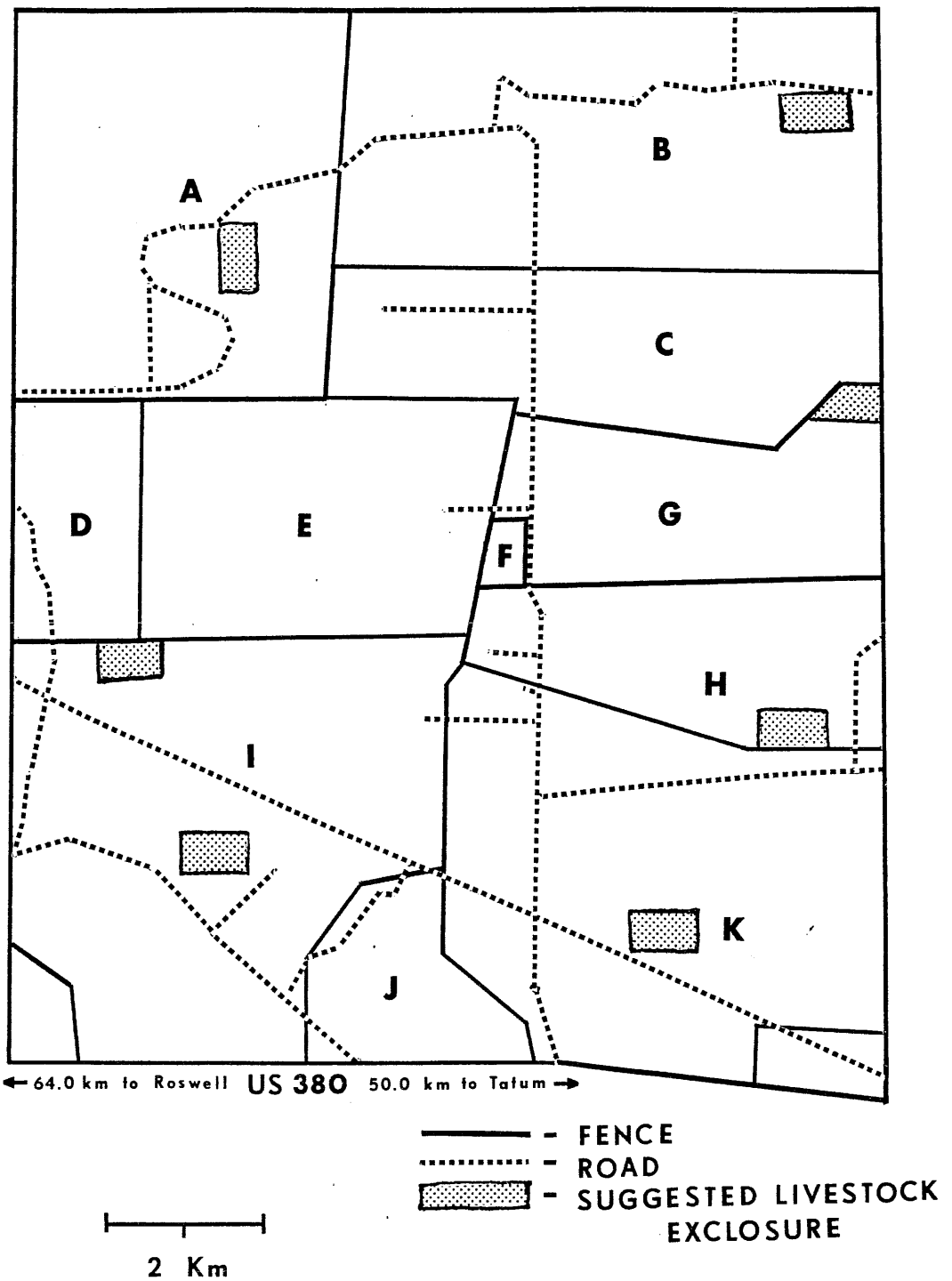

Fig. 21 Suggested locations of livestock exclosures in the study area.

4. Physical disturbance of the area, especially during spring when courtship and reproduction are in progress, should be kept to an absolute minimum. Construction of new facilities, such as fences, and oil exploration work should be prohibited during spring, and nesting habitat in particular should be protected from disturbance. An example of this type of disturbance is the construction of a new road and oil pad, and exploration work begun in the study area in February 1977. This activity is in the 1 large block of prime nesting habitat in the study area. Continuation of these practices will result in a reduction of habitat and a decline in numbers of lesser prairie chickens.

One or 2 booming grounds might be designated as observation sites for interested spectators in order to protect the remainder of the area from indiscriminate travel.

5. Use of types and subtypes described herein for lesser prairie chickens is expected to hold true in other areas of similar habitat. Therefore, the recommendations made above, for the study area, have general applicability in other areas of similar habitat. Habitat development for prairie chickens in southeastern New Mexico should provide the elements (mostly the subtypes of Shinnery Oak-tallgrass) which chickens in the study area use. These elements must be close enough together for individual birds to use each of them as the need arises during a year. This requires that a unit of each element be small enough that birds from its center can move easily to the next element needed. Booming grounds should be within about 3 km

(Figs. 8-15) of both Subtype 3 areas, for use by non-nesting adults, and Subtype 1-2 areas, for use by nesting females. The center portions of nesting habitat, in turn, should be within 1 km of Subtype 3-4 areas for use by broods.

Recommendations for Further Study

This portion of the study has gathered much useful information and has laid the groundwork for more research which is needed. Sample size at present is quite small, and many more data on various aspects of habitat use by lesser prairie chickens in the study area definitely are needed. Nest site and hen movement data are of critical importance, and more need to be added to those collected during the first year of the study. The apparent switch of habitat by broods from brushy areas to more grassy areas during late summer should be investigated further. Data on mobility of both sexes and all ages of birds throughout the year are badly needed in order to coordinate habitat requirements of the species with proper spatial arrangement of required habitat.

Food use should be monitored for several years in order to determine which foods are utilized under varying seasonal and climatic conditions. Accurate census methods, lacking so far in relation to this species, need to be developed.

Extensive data, collected during a series of years, are needed in order to make more confident statements about the habitat requirements of the species. Changing climatic conditions and patterns of use by livestock from year to year will continually

modify the birds' behavior and habitat use patterns, and observations are needed under all conditions. Continued data collection and expansion of research into habitat use and behavior of lesser prairie chickens in eastern Chaves County will allow the development of a much more complete and wide-ranging management plan for this species. With some modification, a management plan of this nature might well be applied to other areas where lesser prairie chickens are found.

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APPENDICES

Appendix A. List of common and Latin names of plants found in study area.

Common Name	Latin Name
Bindweed	*Convolvulus* spp.
Blue grama	*Bouteloua gracilis*
Broad-leaf milkweed	*Asclepias latifolia*
Broom snakeweed	*Gutierrezia sarothrae*
Buckley penstemon	*Penstemon buckleyi*
Buckwheat	*Eriogonum* spp.
Buffalobur	*Solanum rostratum*
Bundleflower	*Desmanthus* spp.
Buttercup	*Ranunculus* spp.
Chaffweed	*Centunculus minimum*
Composite flowers	Asteraceae
Croton	*Croton* spp.
Cryptantha	*Cryptantha jamesii*
Downy phlox	*Phlox pilosa*
Dropseeds	*Sporobolus* spp.
Dwarf dalea	*Dalea nana*
Erect dayflower	*Commelina erecta*
Evening primrose	*Oenothera surrulata*
Evolvulus	*Evolvulus* spp.
False buffalograss	*Munroa squarrosa*

Appendix A. Continued

Common Name	Latin Name
Flax	*Linum Lewisii*
Guara	*Guara villosa*
Hairy grama	*Bouteloua hirsuta*
Hall's panicum	*Panicum hallii*
Hog potato	*Hoffmanseggia densiflora*
Horse nettle	*Solanum eleagnifolium*
Hymenopappus	*Hymenopappus flavescens*
Hymenoxys	*Hymenoxys* spp.
Krameria	*Krameria* spp.
Lemon-scent	*Pectis angustifolia*
Little bluestem	*Andropogon scoparius*
Mesquite	*Prosopis juliflora*
Narrowleaf poisonvetch	*Astragalus pectinatus*
Paperflower	*Psilostrophe villosa*
Paspalum	*Paspalum ciliatifolium*
Prickly Pear	*Opuntia* spp.
Purple prairie clover	*Petalostemon purpureum*
Rabbitbrush	*Chrysothamnus* sp.
Ratany	*Krameria* spp.
Riddell groundsel	*Senecio riddellii*
Sand bluestem	*Andropogon hallii*
Sand lovegrass	*Eragrostis trichodes*

Appendix A. Continued

Common Name	Latin Name
Sand morninglory	*Ipomoea leptophylla*
Sand sagebrush	*Artemisia filifolia*
Sand verbena	*Abronia fragrans*
Sandbur	*Cenchrus* spp.
Scribner's panicum	*Panicum scribnerianum*
Sedge	*Carex* spp.
Sensitive briar	*Schrankia nuttallii*
Sensitive pea	*Cassia nictitans*
Shinnery oak	*Quercus havardii*
Spurge	*Euphorbia* spp.
Threadleaf groundsel	*Senecio longilobus*
Three awns	*Aristida* spp.
Western ragweed	*Ambrosia psilostachya*
Wirelettuce	*Stephanomeria pauciflora*
Wooly locoweed	*Astragalus mollisimus*
Yucca	*Yucca* spp.

Appendix B. List of common and Latin names of insects eaten by lesser prairie chickens.

Common Name	Latin Name
Ants	Formicidae
Beetles	Coleoptera
Butterflies	Lepidoptera
Click beetles	Elateridae
Crickets	Gryllidae
Darkling beetles	Tenebrionidae
Long-horned grasshoppers	Tettigoniidae
Mantids	Mantidae
Mining bees	Halictidae
Roaches	Blattidae
Robber flies	Asilidae
Scarab beetles	Scarabaeidae
Short-horned grasshoppers	Acrididae
Snout beetles	Curculionidae
Spiders	Araneida
Stink bugs	Pentatomidae
Treehoppers	Membracidae