FALL AND WINTER HABITAT OF LESSER PRAIRIE CHICKENS IN SOUTHEASTERN 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

New Mexico State University
Las Cruces, New Mexico
May 1979

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ACKNOWLEDGMENTS

I am grateful to Dr. Charles A. Davis for his help, advice, and guidance throughout my degree program and in the preparation of this manuscript. I also thank Drs. Gary B. Donart, Rex D. Pieper, and Sanford D. Schemnitz for reviewing this manuscript. Dr. Melchor Ortiz provided invaluable assistance in statistical analysis of data.

The project, from which this manuscript was developed, was funded by a contract from the Bureau of Land Management (BLM), U.S. Department of Interior. Special thanks are due to John F. Schwarz, Contracting Officer's Authorized Representative of the BLM, who assisted in planning and in field work. Several other BLM personnel provided assistance in planning and in field work.

The Agricultural Experiment Station, New Mexico State University, provided supplemental funds. The New Mexico Department of Game and Fish provided mist nets, as well as permits to trap, band, and collect prairie chickens.

Thanks are due Mr. Wendell D. Sterrett of Roswell, New Mexico. Mr. Sterrett made available the use of a home-site, electricity, and sanitary facilities during field work. Thanks also are due Mr. Jack Loose, Mr. Bill Martin, Mr. Bill Rushing, and Mr. Harry Rushing, all residents of Caprock, New Mexico, for their help and cooperation while in the field.

To Mike Wisdom and Terry Riley, I express my thanks for their assistance and advice. To my wife, Linda, I express my deep love and appreciation for her support and assistance throughout.

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ABSTRACT

FALL AND WINTER HABITAT OF LESSER PRAIRIE CHICKENS IN SOUTHEASTERN NEW MEXICO

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RANDALL ALAN SMITH, B.S.

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New Mexico State University
Las Cruces, New Mexico, 1979
Dr. Charles A. Davis, Chairman

Fall and winter habitat-use and food habits are described for lesser prairie chickens (Tympanuchus pallidicinctus Ridgway) in Chaves County, New Mexico, from October 1976 through February 1978.

Vegetation of the study area is of two types, Shinnery Oak-Tallgrass and Mesquite-Shortgrass. Shinnery Oak-Tallgrass includes three subtypes, with subtype one having the greatest amount of grass, subtype three the least.

Vertical mist nets and a rocket net were used to capture prairie chickens, which then were equipped with miniature radio transmitters in order to study fall and winter habitat-use. Other chickens were collected by use of a shotgun or .22 caliber rifle, and crop contents were analyzed to determine percent composition of the diet. Relative use of vegetation subtypes was determined by use of census transects.

Census transects revealed that subtype one of Shinnery Oak-Tallgrass received highest relative use, followed by subtype three, subtype two, and the Mesquite-Shortgrass type.

Major food items in the fall diet were shinnery oak acorns, short-horned grasshoppers, insect galls from shinnery oak, and broom groundsel. The fall 1976 diet was high in acorns and low in insects, whereas the fall 1977 diet was higher in insects and lower in acorns. The differences of diets in the two falls are explained by high acorn and low insect availability in 1976, compared to 1977.

The winter diet was mostly acorns, with lesser amounts of green vegetation and very small amounts of insects. The high use of acorns is attributed to the reduced availability of insects and an increased need for a high-energy food source in cold weather. Shinnery oak was a very important food source, supplying from one-fourth to three-fourths of the total diet in fall and winter.

Lesser prairie chickens foraged almost exclusively in the Shinnery Oak-Tallgrass type in fall and winter. In fall, foraging sites generally were higher in grass composition than were overall vegetation subtypes. In winter, the tendency to forage in relatively grassy areas was less evident; chickens often foraged in areas of more shinnery oak.

Roosting/resting sites generally were as high in grass composition as the subtype and higher than foraging sites. Some indication of a lack of adequate roosting/resting cover in subtype three exists, due to the high observed predation rate of radio telemetry birds roosting/resting in subtype three.

Fall display activities on leks occurred from late September through October. Display activities were shorter in daily duration and less intense in fall than in spring. No females were seen on leks in fall.

Flock size decreased from an average of eight birds in November to two birds in February.

Restoration of tallgrass cover is recommended, especially in subtypes two and three. Partial brush removal in subtype three may be necessary to insure reestablishment of tall grasses.

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INTRODUCTION

The lesser prairie chicken (Tympanuchus pallidicinctus Ridgway) is a gallinaceous bird of the grouse family (Tetraonidae).[1] Its original range (Fig. 1) included southwestern Kansas, western Oklahoma, portions of western Texas, eastern New Mexico, southwestern Colorado, possibly northeastern Colorado, and southwestern Nebraska (Copelin 1963, Crawford 1974, Sharpe 1968). According to the American Ornithologists' Union (1957), the species was formerly migratory, and has been recorded as far east as southeastern Kansas and southern Missouri, wintering in southeastern New Mexico and central Texas. Bones of the lesser prairie chicken from the Pleistocene have been found in Oregon (Crawford 1974), suggesting a larger range or at least a different distribution in prehistoric times.

The habitat of the lesser prairie chicken is arid grasslands of mid and tall grasses with interspersed shrub and half-shrub vegetation, principally shinnery oak and sand sagebrush (Aldrich 1963, Copelin 1963, Jones 1963, U.S. Fish and Wild. Serv. 1968).

At one time, the lesser prairie chicken was common to abundant over most of its range. According to Bailey (1928), the species was abundant in southeastern New Mexico in the mid-1800s

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[1] Other scientific names are contained in Appendix A.

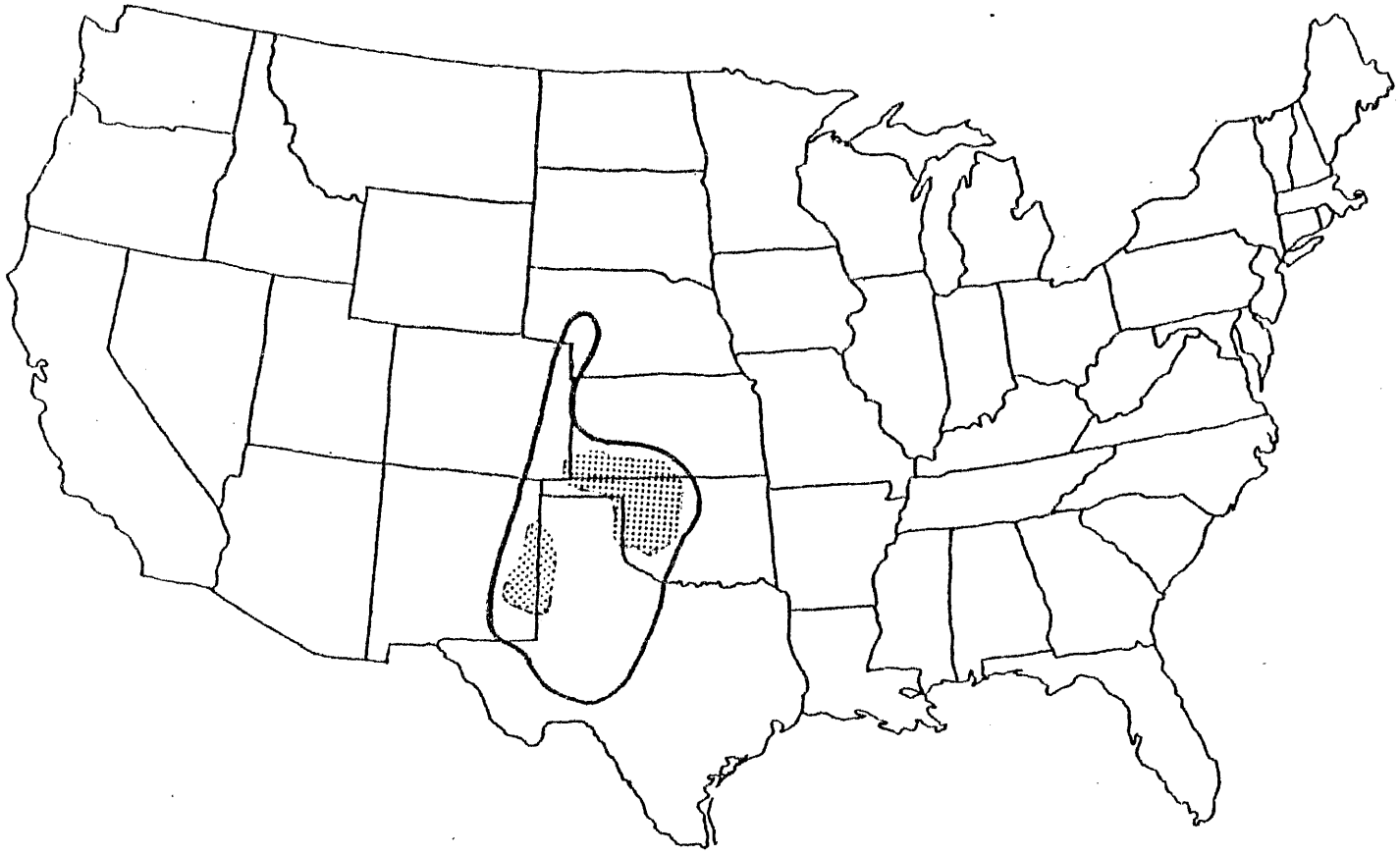

Fig. 1. Former (solid line) and current (dots) distribution of the lesser prairie chicken in the United States (Aldrich 1963, Copelin 1963, Crawford 1974, Jackson and DeArment 1963, Johnsgard 1973, Sharpe 1968).

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but, even then, experienced population fluctuations. Bent (1932) identified the early 1900s as the period of greatest abundance.

The patchwork type of farming of the late portion of the nineteenth century provided an additional source of winter food, which probably caused increased abundance (Sharpe 1968). Jackson and DeArment (1963) stated that patchwork farming interrupted the continuity of the grasslands without any great amount of infringement by introducing dry-land sorghums to the area, thus providing an important supplemental winter food source. Reed (1904) stated that the lesser prairie chicken was becoming more scarce each year in parts of its range as early as 1904. By 1930, cultivated land had expanded greatly and blocked ancestral travel patterns; heavy hunting and the drought beginning in 1934 worsened the plight of the lesser prairie chicken, depressing the populations to a "scarcity level hitherto unknown" (Jackson and DeArment 1963:733). Bent (1932) blamed overgrazing and extensive cultivation for the reduction in range and numbers. Lee (1950) cited the combination of overgrazing and drought of the 1930s as having serious effects on the species. Davison (1940) believed that overhunting during the drought of the 1930s had a very detrimental effect on numbers of the chickens. He based his observation on the good condition of birds he collected at that time. The U.S. Fish and Wildlife Service (1968) stated that the species nearly reached extinction in the 1930s.

In 1968, the lesser prairie chicken was considered a rare species by the U.S. Fish and Wildlife Service (1968). The population was described as fluctuating, with 2,000 to 30,000 birds in Oklahoma, and 10,000 to 50,000 in New Mexico. Johnsgard (1973) estimated the total population as a few hundred in Colorado, 3,000 in Texas, 15,000 in Oklahoma, 10,000 to 15,000 in Kansas, and 8,000 to 10,000 in New Mexico for a total population of 36,000 to 43,000.

The U.S. Fish and Wildlife Service (1968) described lesser prairie chicken abundance in 1968 as decreasing, with status particularly precarious where there had been widespread removal of brush. Jackson and DeArment (1963) found that brush removal by use of 2, 4,-D (2, 4-dichlorophenoxyacetic acid) reduced both the winter food supply and cover, and that only when brush began to reinvade the area did any lesser prairie chickens return.

Another pressing problem is habitat destruction due to center pivot irrigation. Dry-land farming has been marginal in many areas, but center pivot irrigation allows for rapid expansion of cultivation into areas of native rangeland that are favored lesser prairie chicken habitat. Satellite pictures have revealed that, in Kansas, lesser prairie chicken habitat has been reduced by three percent in just two years (1975-1976) due to rapid expansion of center pivot irrigation. Waddell and Hanzlick (1978) estimated that, at this rate, 40 percent of the area which the lesser prairie chicken occupies in Kansas will be cultivated

by the mid-1980s. This degree of conversion to cultivation probably will result in eradication of the lesser prairie chicken from southwestern Kansas; Crawford (1974) found that, in western Texas, areas with more than 37 percent cultivation are incapable of supporting permanent populations of lesser prairie chickens. Overgrazing, brush control, and cultivation all are problems the lesser prairie chicken faces in areas of its present distribution.

Several states and the federal government have lands on which the lesser prairie chicken occurs. Due to the growing concern over the status of this bird, these governments have become increasingly interested in its management. Colorado has restricted grazing and has released birds obtained from Kansas on several small management areas in the southeastern portion of the state. New Mexico has approximately 24,000 acres reserved for lesser prairie chicken management. Also in New Mexico, the Bureau of Land Management administers large tracts of land on which lesser prairie chickens occur and are subject to some management efforts.

Research has been conducted on the lesser prairie chicken previously, but detailed information is far from abundant. Little information is available on fall and winter habitat-use, requirements, and behavior. Jones (1963), in a comparative study of lesser and greater prairie chickens in Oklahoma, conducted some fall and winter work. He used vegetation analysis

of a general nature to describe height, life-form, coverage, and dispersion of vegetation.

Other published studies on the lesser prairie chickens contain little information on fall and winter habitat-use. Copelin (1963), in Oklahoma, concentrated mostly on lek activity, movements, nesting, and brood-rearing habitat. He conducted little fall and winter work other than study of fall lek activities. Crawford (1976) concentrated on land-use effects in relation to lesser prairie chickens in western Texas, and conducted little fall and winter work.

To meet the need for additional management information on the lesser prairie chicken, this study was conducted with three main objectives: (1) to determine the vegetational characteristics of habitat used in fall and winter for foraging and roosting/resting; (2) to determine fall and winter food habits and how they relate to vegetational use; and (3) to observe fall and winter behavior, such as fall lek activities and flock size. Field work was conducted mostly from September 1977 through February 1978, although some food habits data from fall and winter of 1976-77 also were utilized. The study was conducted approximately 64 km east of Roswell, in southeastern New Mexico (Fig. 2).

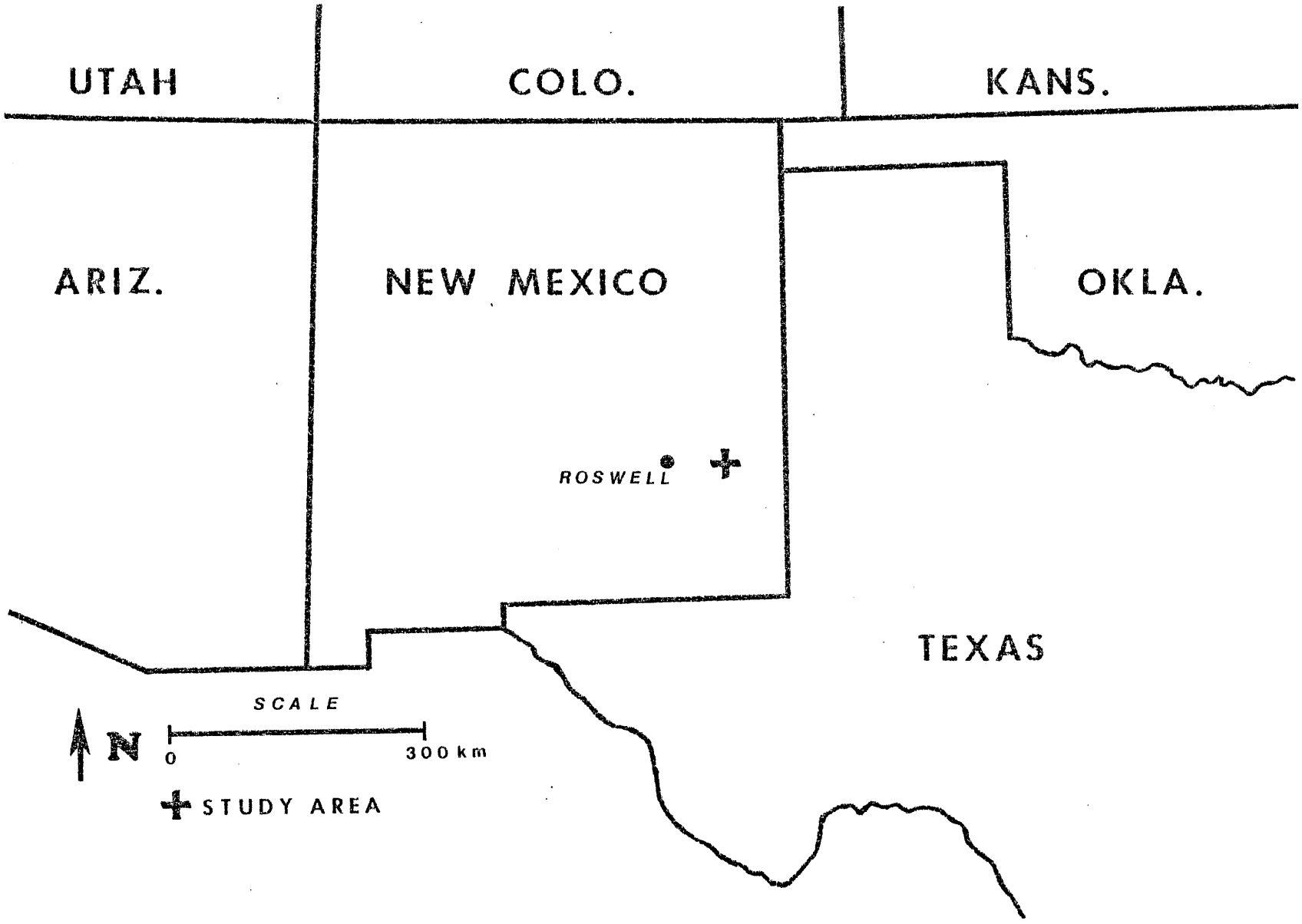

Fig. 2. Location of study area in relation to southwestern United States.

STUDY AREA

The study area (approximately 15,500 ha) was located mostly on public lands in the East Chaves Planning Unit of the Roswell, New Mexico, District of the Bureau of Land Management (BLM), U.S. Department of the Interior. A few small tracts of land in the area were privately owned.

The general region of the study area is part of the plains grasslands or Great Plains (Garrison et al. 1977). Topography is dominated by gently sloping to rolling sandy plains. The soils are deep and are developing in sandy eolian (wind-deposited) and alluvial sediments (Maker et al. 1971). Duney and hummocky areas are common, and some actively eroding dunes, barren of vegetation, are present. The primary soil association is the Jalmar-Tivoli-Faskin association. This association is composed of fine sands, sand loams, and, in some cases, light, sandy clay loam.

Riley (1978) described vegetation of the area as consisting of two principal types: the Shinnery Oak-Tallgrass type, occurring on the deep sand soils which dominate the area, and the Mesquite-Shortgrass type, occurring on small areas of shallow, clay-pan soils (Fig. 3; Appendix B). The Shinnery Oak-Tallgrass type includes considerable shrub growth, especially shinnery oak, sand sagebrush, and yucca. The three subtypes of Shinnery Oak-Tallgrass are distinguished primarily by the relative amounts of

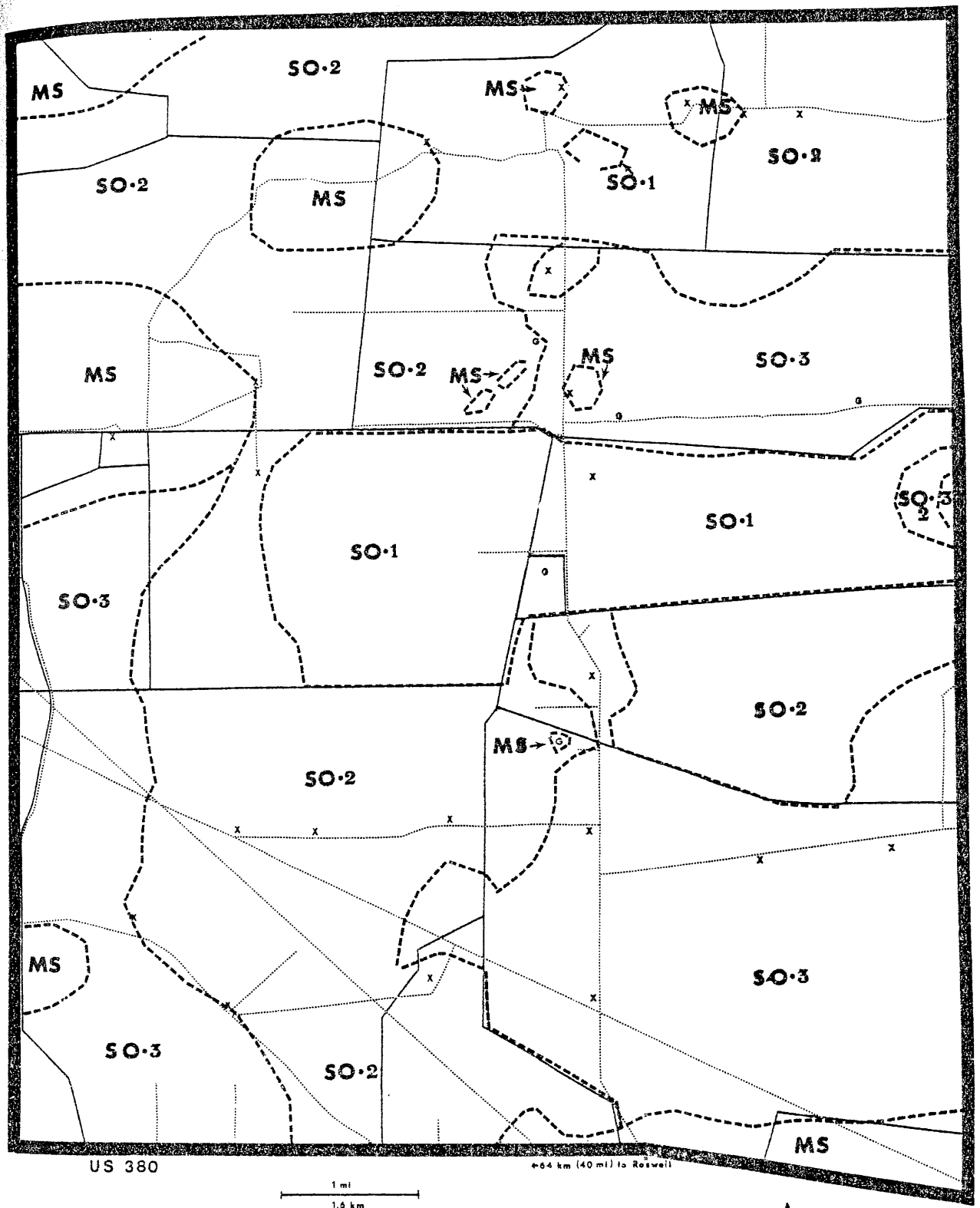

Fig. 3. Study area.

sand bluestem. This species makes up progressively less of the vegetational composition from subtype one through subtype three. The abundance of grasses in subtypes one and two is accompanied by less shrub growth in comparison to subtype three, where shrubs (especially shinnery oak) compose a larger percentage of the vegetational composition than do grasses. Vegetational cover and ground litter are greatest in subtype one. The primary use of the area is for livestock grazing, mostly by cattle. Another use is for production of oil and gas.

Chaves County, in which the study area occurs, is characterized by a semiarid, continental climate with distinct seasons. A wide range of diurnal and annual temperatures occur, with moderately low rainfall and plentiful sunshine (Maker et al. 1971). A general southeasterly circulation from over the Gulf of Mexico acts as the principal source of moist air. Much of the rainfall occurs from brief but often intense thunderstorms, with three-fourths of the annual precipitation occurring during the growing season, May through October.

Temperatures for 1976, 1977, 1978, and the 30-year average are shown in Figure 4. Precipitation for 1976, 1977, and 1978, and the 30-year average precipitation are shown in Figure 5. Data for both temperature and precipitation were collected at Maljamar, New Mexico, approximately 60 km southeast of the study area. Temperatures for the three years of the study were near

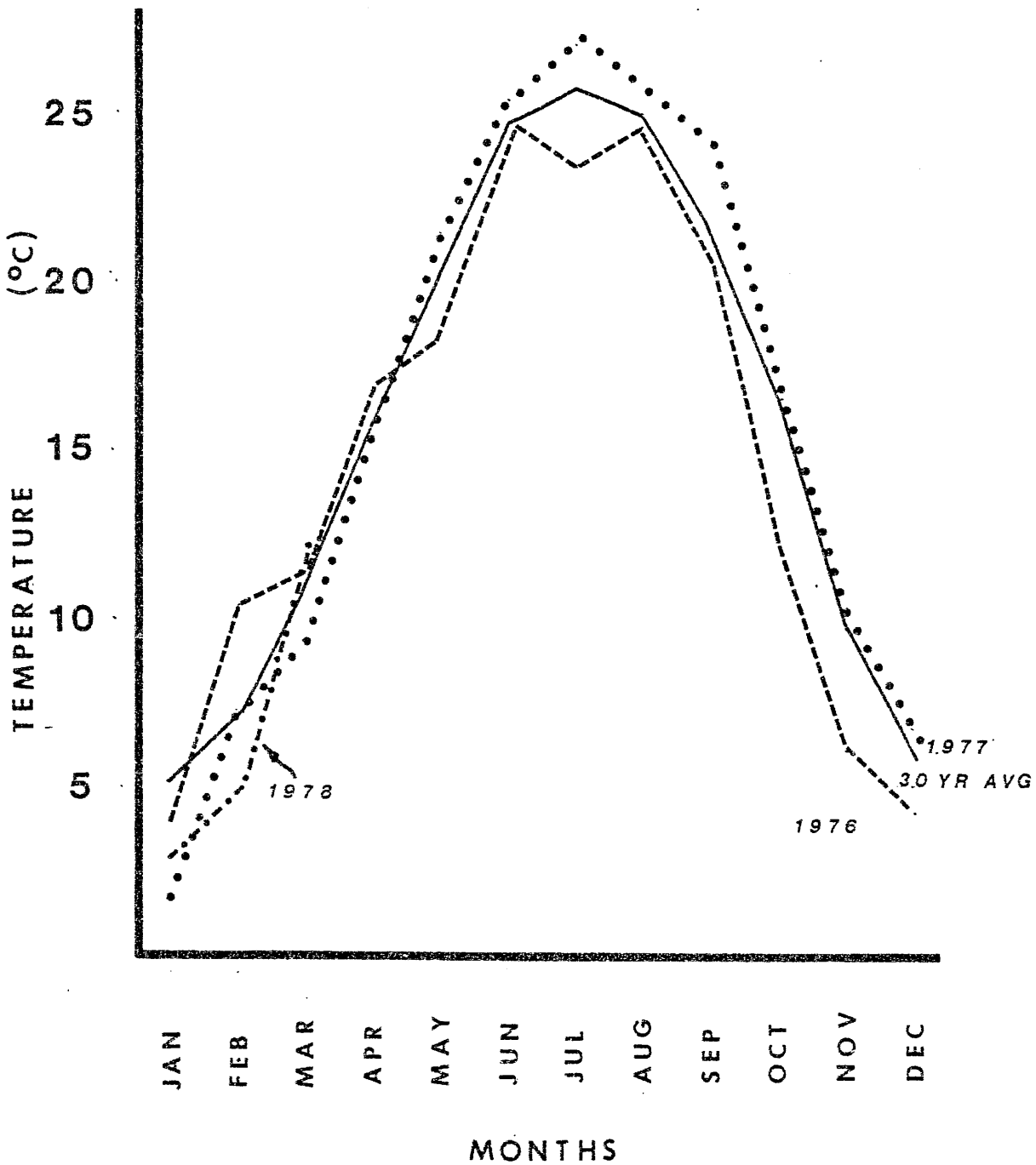

Fig. 4. Average monthly temperatures at Maljamar, New Mexico (U.S. Dept. of Comm. 1976, 1977, 1978; Gabin and Lesperance 1977).

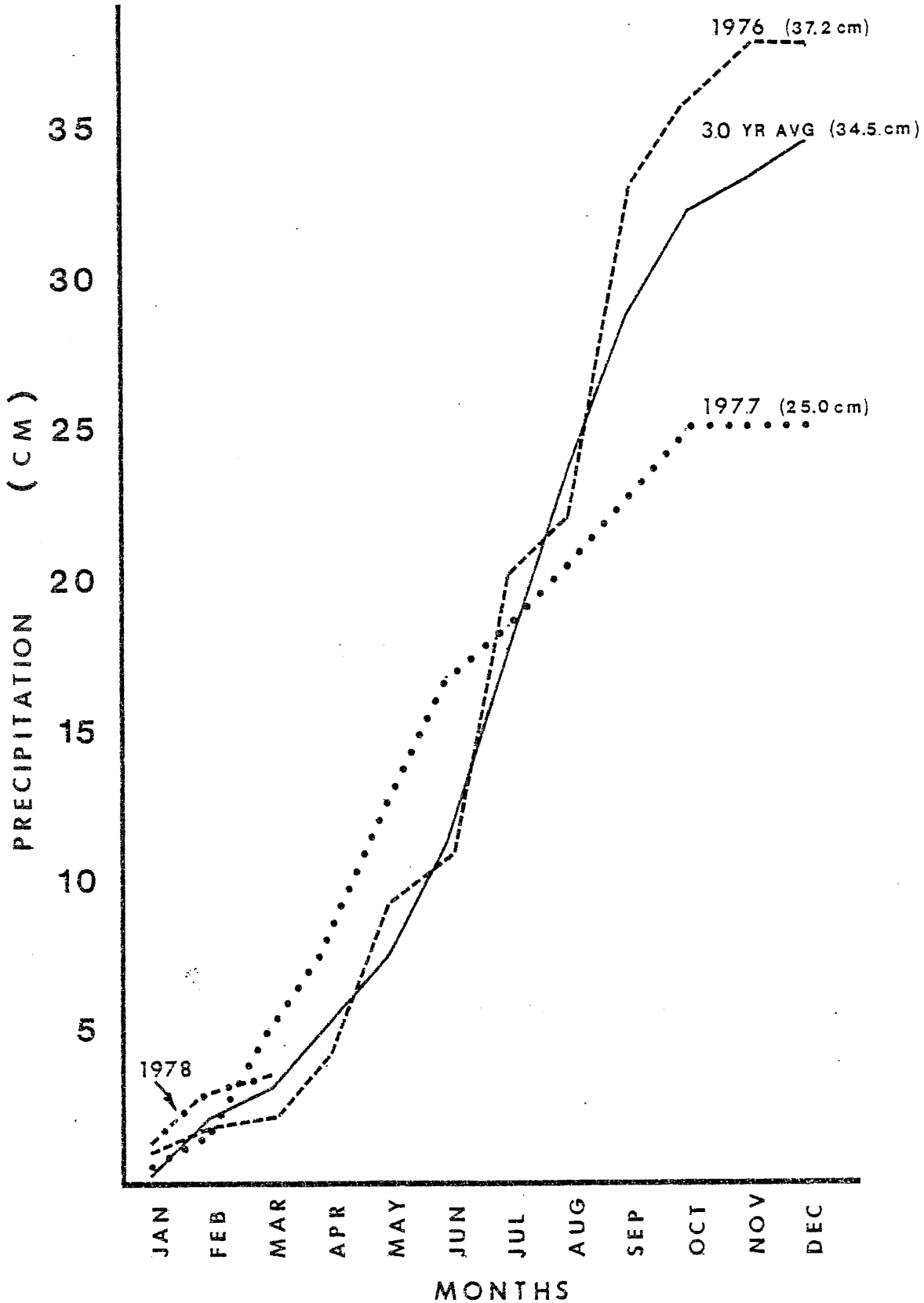

Fig. 5. Cumulative precipitation at Maljamar, New Mexico (U.S. Dept. of Comm. 1976, 1977, 1978; Gabin and Lesperance 1977).

the 30-year average except that the summers of 1977 and 1978 were higher. Fall and winter of 1976-77 were colder than normal.

Precipitation varied greatly during the study. Rainfall for 1976 was near the 30-year average until September, when late rains put the annual rainfall well ahead of average. In contrast, 1977 started out ahead, but, due to a lack of rain in late summer and fall, fell far below the 30-year average.

METHODS

Live Trapping

Trapping was begun on 24 September 1977 and continued through 31 October 1977. A total of 21 males were captured during 13 days (15 man-days) of trapping. Two birds died as a result of trapping efforts, resulting in a mortality rate of nine and one-half percent.

A combination method of trapping was used, employing a rocket net and a mist net, to trap on five different leks. The mist net was erected vertically along one edge of the lek, and the rocket net was placed near the center or slightly toward the edge of the lek opposite the mist net. The rocket net was placed so that it would fire toward the mist net, to aid in driving chickens from the lek into the mist net. The blind from which the rocket net was fired was placed to the rear or to one side of the rocket net. This setup was easily manned by one person, as the rocket net acted well to drive chickens into the mist net, allowing the capture of several birds at once.

Eleven birds were captured with the rocket net, and ten birds with the mist net. The rocket net took less setup time, was easier to use, and injured the birds less than did the mist net.

Telemetry

Eight of the 21 chickens captured were fitted with radio transmitters so that their habitat-use could be studied. Two transmitters were lithium battery-powered and were built by Sidney L. Markusen of Esko, Minnesota. The original design was modified in the field so that it resembled that of Brander (1968). This included removing the battery from its breast location to the back of the bird and taping battery and transmitter together to form a backpack. An elastic band was used as a harness to hold the pack in place. In case of predation, this design allowed a greater chance of continued transmission by reducing the chance of the predator loosening one of the wires connecting battery and transmitter. Some weight reduction was achieved by this modification, due to the removal of harness material and wire, resulting in a total package weight of approximately 18 g.

The other six transmitters used nickel-cadmium batteries, which were charged by solar panels on top of the package. The solar-charged transmitter package, consisting of harness, antenna, and transmitter, weighed approximately 18 g and was built by Wildlife Materials, Inc., Carbondale, Illinois. The harness consisted of flat elastic cord looped around one shoulder, passed through the holes at the front and rear of the transmitter package, and tied under the other shoulder. The elastic harness

allowed a tight fit and also expansion for wing mobility. The knot and ends of the elastic cord were heated and melted slightly with a match to prevent fraying and slippage.

The transmitters operated in the frequencies 150-152 mHz. Each operated on a specific frequency, allowing distinction among birds. Birds were located using a hand-held yagi antenna and portable receiver purchased from Wildlife Materials, Inc.

Locations of birds were determined by going to a bird's last known location and scanning to obtain the general direction of the radio signal. The exact location was obtained then by triangulation of the radio signal or by walking a large circle around the radio signal and bird. On two occasions, the study area was searched using a Cessna airplane with the yagi antenna mounted on the strut of the aircraft for radio tracking. From the air, signals were received from distances up to 13 km, aiding greatly in locating lost radioed chickens. Locations of chickens were marked on aerial photo overlays.

Two birds from each of four leks were equipped with radio transmitters. All birds captured were weighed, sexed and aged (Campbell 1972), and banded with serially numbered aluminum leg bands furnished by the New Mexico Department of Game and Fish.

Use-Site Analysis

Individual use-sites (foraging sites, roosting/resting sites) were found by radio location, during searches of the study area by

horseback, and incidental to other work. Vegetation analysis was conducted on use-sites by two techniques which are described below.

Vegetation at foraging sites was analyzed by use of a four-arm pace transect containing 100 data points. The transect was centered on the use-site, with an arm extending 25 paces in each of four directions (north, east, south, and west). At each step of the right foot along the line, a data point was located at the toe of the boot. At this point, it was noted whether a plant base was present and, if not, whether the point was bare or covered by litter. The name of the nearest live plant ahead (180 degrees forward) of the point was recorded if none was present on the point (Evans and Love 1957).

At roosting/resting sites, an eight-arm, line-point transect was used. The arms extended ten feet in each direction (north, northeast, east, etc.) from the center of the use-site. Points were located at one-foot intervals, so that each transect provided a total of 80 data points. The same data were collected as from the four-arm transect.

The smaller, more compact eight-arm transect was used at roosting/resting sites because sites were small in size and it was believed that a circle of 10-foot radius would adequately describe the vegetation surrounding the site. The larger, four-arm transect was used at foraging sites because foraging did not take place at one specific spot but over a general area, as

tracks of the birds revealed. Thus, a larger transect was believed to be more descriptive of the general vegetation and area in which birds foraged.

Food Habits Analysis

Food habits were studied by examination of crop contents from birds collected October through February, mostly by shotgun or .22 caliber rifle. Some crops were donated by hunters, and two were taken from birds that died as a result of trapping.

Contents from each crop were analyzed separately. Foods were measured by volumetric 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).

Relative Use of Types and Subtypes

An effort was made to determine whether relative use varied among vegetation types and subtypes. East-west lines (census transects) were established across the study area at half-mile intervals. The number of miles of transect in each vegetation type and subtype was made proportional to the percent of the study area occupied by that type/subtype. These lines were traveled once by horseback over a period of one month (16 January to 16 February 1978), and observations were made of prairie chickens and their sign (tracks and droppings) along these lines.

Each encounter with a chicken (or a flock), or with prairie chicken sign, was tallied as one observation. The number of observations in each subtype of Shinnery Oak-Tallgrass, or in the Mesquite-Shortgrass type, was divided by the number of kilometers of census route in that subtype or type to produce a use-index (encounters per km).

A similar index was calculated for birds contacted by radio location. In this calculation, the number of encounters in a type or subtype was divided by the percent of the study area occupied by that type or subtype.

Statistical Analysis

Comparisons of mean values resulting from vegetation sampling were made using the Z statistic (Lentner 1975). The null hypothesis was that no difference exists between the means compared. The statistic ($P > |Z|$) presented in the tables is the probability of a Type I error (rejection of the null hypothesis, when in fact it is true).

Comparisons of means from ground cover data were made using Student's *t* test (Lentner 1975). The statistic ($P > |T|$) shown in the tables is the probability of a Type I error.

Food habits data comparisons were made using the Permutation Test (Sokal and Rohlf 1969). This test considers the observed results as one of many possible outcomes that could have occurred by chance. A random subset of all possible permutations of the

observed values is computed. Each permutation produces a test statistic (difference between means). Together, these test statistics produce a distribution of the test statistic. On the basis of the distribution of possible outcomes, it is determined whether the observed outcome of the two means is deviant enough to warrant rejection of the null hypothesis (Ho: observed result could have occurred by chance). Due to the complex computation required to determine the subset of possible outcomes and their distribution, computer analysis was a necessity. For example, in the case of fall 1976 versus fall 1977 food habits, the subset consisted of 10,000 outcomes. The statistic shown in the tables is the probability of a Type I error.

USE OF VEGETATION TYPES AND SUBTYPES

Vegetation of the subtypes of the Shinnery Oak-Tallgrass type is described in Appendix Table 25. Subtype one is dominated by grasses (especially sand bluestem) and by shinnery oak, a shrub. Subtypes two and three have progressively less sand bluestem, and subtype three also is more brushy than the other subtypes. The Mesquite-Shortgrass type (Appendix Table 26) is dominated by blue grama and buffalo grass; in many shortgrass areas, mesquite is the most conspicuous shrub, although it is insignificant in the overall composition. The Mesquite-Shortgrass type has more plant cover and less litter than does the Shinnery Oak-Tallgrass type (Appendix Table 27).

In fall-winter, use of types and subtypes was sampled by traversing the study area (66 sq km) along a total of linear kilometers of census transect, and also by recording all radio locations of prairie chickens. Both these techniques showed greatest prairie chicken use in Shinnery Oak-Tallgrass subtype one, second greatest use in subtype three, third greatest in subtype two, and least in Mesquite-Shortgrass (Table 1).

Davis et al. (1979) reported similar findings from work in the same study area in other seasons. On the basis of these two studies (Davis et al. 1979, and this study), it appears that subtype one of Shinnery Oak-Tallgrass is the preferred habitat of the lesser prairie chicken in eastern New Mexico, and that subtypes

Table 1. Relative use of Shinnery Oak-Tallgrass subtypes and Mesquite-Shortgrass type by lesser prairie chickens.

Technique and unit of measure	Shinnery Oak-Tallgrass Subtypes 1	2	3	Mesquite-Shortgrass
Census transects no. encounters/km[a]	0.74(19)[b]	0.43(74)	0.68(52)	0.0 (19)
Radio-location no. encounters/ % of area[c]	3.20(12)[d]	0.82(44)	2.40(33)	0.70(11)

[a]Number of encounters with either birds or their sign per linear kilometer of transect in that vegetation type or subtype.

[b]Number of linear kilometers of transect in the vegetation type or subtype.

[c]Number of encounters via radio location in the vegetation type or subtype, divided by the percent of the study area occupied by the type or subtype.

[d]Percent of the study area occupied by the vegetation type or subtype.

two and three are less desirable, possibly marginal. Mesquite-Shortgrass will not support populations of the species and is rarely used except for lek sites.

If subtypes two and three are marginal habitat, one might expect that the prime habitat (subtype one) would be used mostly by adults, and that juveniles would be forced to make greater use of the more marginal habitat. Of ten juveniles collected in the fall of 1978, eight birds (80 percent) were taken from subtype three, two (20 percent) from subtype two, and none from subtype one. Although the juvenile data come from a small sample, which may have been biased, collecting was carried out in all three subtypes and the data may be an indication of the true situation.

FOOD HABITS

Food habits for fall were determined from crops collected during October through December, 1976 and 1977. Winter food habits were determined from crops collected in January and February, 1977 and 1978. December was included in the fall sample because, although it is a transitional month, all but four December crops were collected before 10 December, when weather was more fall-like.

Data from the two falls, 1976 and 1977, were separated for two reasons. First, sample size (26 crops) was large enough to justify separation statistically. Second, in the fall of 1976, prevailing temperatures were lower than the 30-year average (Fig. 4), whereas fall 1977 temperatures were at or slightly above the 30-year average. These temperature differences no doubt resulted in different availabilities of insects and possibly green vegetation.

Data from the two winters, 1976-77 and 1977-78, were combined for two reasons. First, the small sample size (six crops) prevented separation for statistical purposes. Second, both winters apparently were sufficiently cold (Fig. 4) to result in uniformly low availability of insects and green vegetation. Thus, it is believed that the composite winter sample is representative of either winter, as food availability was restricted to a large reliance on acorns in both winters.

Fall Diet

Major food items (composing more than ten percent of the diet in at least one fall) were shinnery oak acorns, short-horned grasshoppers, broom groundsel leaves, and insect galls from shinnery oak (Table 2). Thirty different kinds of food items were eaten, nearly half being green vegetation.

The diets of the two falls (1976 and 1977) were strikingly different (Table 3). In 1976, mast and seeds (mostly acorns) composed nearly two-thirds of the diet, vegetative material almost one-third, and animal material was minor. In 1977, mast and seeds made up less than one-fourth of the diet, vegetative material almost one-half, and animal material slightly more than one-fourth. Diets of the two falls included significantly[2] different proportions of each of the following: shinnery oak acorns, short-horned grasshoppers, total mast and seeds, total vegetative material, and total animal material.

The difference in diets of the two falls can be explained, at least in part, by two factors. First, in the fall of 1977, acorn production was so low that the phenomenon was obvious to all workers in the field. Second, cooler temperatures for fall 1976 no doubt resulted in a different availability of insects and possibly green vegetative material.

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[2]Herein, "significant" indicates $P < 0.05$ and "highly significant" indicates $P < 0.01$.

Table 2. Fall and winter food habits of lesser prairie chickens.

Food item	Mean percent composition		
	Fall 1976(9)[a]	Fall 1977(17)	Winter (6)
Mast and Seeds			
Shinnery oak acorns	61.6	16.8	69.3
Spurge seeds	4.4	-[b]	-
Narrowleaf gromwell seeds	-	3.7	-
Spectacle pod seeds	-	t[c]	-
Total Mast and Seeds	66.0	20.5	69.3
Vegetative Material			
Insect galls from shinnery oak	13.5	5.4	-
Broom groundsel (leaves)	-	12.9	4.9
Wildbuckwheat (leaves)	-	1.1	8.4
Dwarf dalea (leaves)	5.9	6.8	-
Wildbuckwheat (shoots)	-	5.9	5.5
Downy phlox (leaves)	3.9	-	3.5
Narrowleaf gromwell (leaves)	-	3.9	0.2
Composite (buds)	-	3.8	-
Evening primrose (leaves)	-	3.6	-
Spurge (leaves)	2.8	1.1	0.6
Bitterweed (leaves)	-	1.9	0.4
Shinnery oak (leaves)	1.3	1.6	-
Buckley penstemon (leaves)	-	0.7	1.9
Broom snakeweed (leaves)	-	1.2	0.5
Rubber rabbitbrush (leaves)	-	-	0.1
Total Vegetative Material	27.4	49.9	26.0
Animal Material			
Short-horned grasshoppers	1.8	27.5	-
Ground beetles	-	0.4	4.7
Crickets	2.9	0.3	-
Caterpillars	1.9	-	-
Long-horned grasshoppers	-	0.6	-
Shield-backed bugs	-	0.3	-
Scentless plant bugs	-	0.3	-
Walking sticks	-	0.1	-
Treehoppers	t	-	-
Spiders	t	-	-
Ants	-	-	t
Weevils	-	-	t
Unidentified beetles	-	0.1	-
Total Animal Material	6.6	29.6	4.7

[a]Number of crops.

[b]Zero.

[c]Trace (less than 0.1 percent).

Table 3. Statistical comparison[a] of selected food items eaten by lesser prairie chickens.

Food item	Mean percent composition		Alpha[c]
	Fall 1976(9)[b]	Fall 1977(17)	
Shinnery oak acorns	61.6	16.8	0.0015
Total mast and seeds	66.0	20.5	0.0014
Total vegetative material	27.4	49.9	0.0483
Short-horned grasshoppers	1.8	27.5	0.0032
Total animal material	6.6	29.6	0.0113

[a]Permutation Test (Sokal and Rohlf 1969).

[b]Number of crops.

[c]Probability of a Type I error.

In the fall of 1976, prairie chickens relied heavily on acorns because of their abundance in combination with the low availability of insects and vegetative material. In the fall of 1977, chickens relied less on acorns due to their lower availability (compared to fall 1976) and the greater abundance of insects and vegetative material.

Winter Diet

Winter foods (Table 2) were mostly mast and seeds (acorns), with lesser amounts of green vegetation and very small amounts of insects. The great use of acorns is attributed mostly to the need for a high energy source to sustain body temperature in cold weather. The greater use of acorns also may have been partly related to further decline in availability of insects coincident with colder temperatures.

Statistical comparisons of each of the two fall diets with the winter diet (years combined) were made for acorns, short-horned grasshoppers, total mast and seeds, total vegetative material, and total animal material. No significant differences were found between fall 1976 and winter items, whereas all comparisons between fall 1977 and winter items revealed significant differences (Tables 4 and 5). Similarity of the fall 1976 diet and the winter diet probably was a result of unusually low fall temperatures (Fig. 4). Hence, the fall 1976 diet was much like the winter diet. Temperatures in fall 1977 were much like the

Table 4. Statistical comparison[a] of selected food items eaten by lesser prairie chickens.

Food item	Mean percent composition		Alpha[c]
	Fall 1976 (9)[b]	Winter (6)	
Shinnery oak acorns	61.6	69.3	0.3317
Total mast and seeds	66.0	69.3	0.4068
Total vegetative material	27.4	26.0	0.4699
Short-horned grasshoppers	1.8	0.0	0.4029
Total animal material	6.6	4.7	0.4721

[a]Permutation Test (Sokal and Rohlf 1969).

[b]Number of crops.

[c]Probability of a Type I error.

Table 5. Statistical comparison[a] of selected food items eaten by lesser prairie chickens.

Food item	Mean percent composition		Alpha[c]
	Fall 1977 (17)[b]	Winter (6)	
Shinnery oak acorns	16.8	69.3	0.0009
Total mast and seeds	20.5	69.3	0.0012
Total vegetative material	49.9	26.0	0.0193
Short-horned grasshoppers	27.5	0.0	0.0000
Total animal material	29.6	4.7	0.0221

[a]Permutation Test (Sokal and Rohlf 1969).

[b]Number of crops.

[c]Probability of a Type I error.

30-year average, resulting in a wider food availability and, therefore, a diet different from that of winter.

Few studies provide comparative food habits data. Frary (1957) reported crop contents from 17 lesser prairie chickens taken in the vicinity of Milnesand and Crossroads, about 20-40 miles northeast of the present study area. His sample of 17 birds was taken from six different months and analyzed as one unit, so that careful seasonal comparisons with present data are impossible. He found that vegetative material was very important in winter and early spring and that acorns were important in winter. Insects were very important in early fall (September-October).

Crawford and Bolen (1976) reported fall foods based on 90 birds collected by hunters in mid-October of 1971-73 (30 birds per year). These birds were collected in Cochran County, Texas, approximately 50-60 miles northeast of the present study area. Only general comparisons between their data and those of the present study can be made, due to difference in study areas (theirs had grain fields). Despite this difference, it is clear that shinnery oak is the principal natural food, in fall, in both areas. This species provided acorns, galls, and leaves, which made up 50.1 percent of the fall diet in the present study and 36.4 percent of the natural foods (excluding grain sorghum) in the study by Crawford and Bolen (1976). The other principal finding common to both studies is that short-horned grasshoppers

were the principal animal food, and the second-ranking food, in fall. They made up 14.7 percent of the fall diet in the present study, and 21.1 percent of the natural foods (excluding grain sorghum) in the study by Crawford and Bolen (1976).

It is clear, from this study and the two cited above, that shinnery oak acorns are an important food source, especially in areas devoid of grain sorghum. Due to the heavy reliance on acorns, any brush control should be carefully planned. Only partial kills on relatively small tracts of land should be attempted, to avoid elimination of shinnery oak as a food source.

FORAGING HABITAT

Prairie chickens were found almost exclusively in the Shinnery Oak-Tallgrass type in fall and winter. Grass and shrub vegetation at foraging sites in this type was dominated by grasses (53 to 71 percent), but shinnery oak was the single most important plant species, making up 28 to 43 percent of the vegetation (Tables 6-11). Forbs were not sampled because of their scarcity. Foraging in the Mesquite-Shortgrass vegetation type was negligible, so vegetation at foraging sites in this type was not sampled.

Fall Foraging Sites Versus Subtype

In each of the three subtypes of Shinnery Oak-Tallgrass, prairie chickens foraged where vegetation was higher in grass composition (differences highly significant)[3] than was the mean of the grass composition in the subtype (Tables 6, 7, and 8).

The use of relatively grassy areas may have been a result of shinnery oak losing its leaves. Grass cover may then afford more protection from predators and inclement weather. Thus, prairie chickens would tend to avoid the brushy, comparatively open areas and utilize the grassier areas.

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[3]Herein, "significant" indicates $P < 0.05$, and "highly significant" indicates $P < 0.01$.

Table 6. Percent basal composition of vegetation in subtype 1 versus that at foraging sites of lesser prairie chickens in subtype 1.

Species	Subtype 1 (6000)[a]	Fall (700)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	30.3	14.4	< 0.001
Little bluestem	5.9	7.4	< 0.200
Dropseed	3.8	12.3	< 0.100
Three-awn	8.6	18.7	< 0.001
Hairy grama	8.1	8.6	> 0.500
Fall witchgrass	5.1	9.3	< 0.001
Other	3.5	0.4	
Total Grasses	65.3	71.1	< 0.005
Shrubs			
Shinnery oak	32.7	21.9	< 0.001
Sandsage	0.6	1.9	
Yucca	0.8	2.7	
Mesquite	0.0	2.0	
Other	0.6	0.4	
Total Shrubs	34.7	28.9	< 0.005

[a]Six thousand data points from 30 transects.

[b]Seven hundred data points from 7 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 7. Percent basal composition of vegetation in subtype 2 versus that at foraging sites of lesser prairie chickens in subtype 2.

Species	Subtype 2 (12000)[a]	Fall (500)[b]	P > |Z|[c]
	Mean	Mean	
Grasses			
Sand bluestem	9.6	7.6	< 0.200
Little bluestem	13.6	12.4	< 0.500
Dropseed	4.1	13.4	< 0.001
Three-awn	18.8	21.4	< 0.200
Hairy grama	7.5	8.8	< 0.500
Fall witchgrass	5.2	5.8	> 0.500
Other	6.5	2.8	
Total Grasses	65.3	72.2	< 0.002
Shrubs			
Shinnery oak	32.7	24.2	< 0.001
Sandsage	0.3	0.2	
Yucca	1.5	2.0	
Mesquite	0.0	0.0	
Other	0.2	1.4	
Total Shrubs	34.7	27.8	< 0.002

[a]Twelve thousand data points from 60 transects.

[b]Five hundred data points from five transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 8. Percent basal composition of vegetation in subtype 3 versus that at foraging sites of lesser prairie chickens in subtype 3.

Species	Subtype 3 (6400)[a]	Fall (1000)[b]	P > |Z|[c]
	Mean	Mean	
Grasses			
Sand bluestem	5.7	1.2	< 0.001
Little bluestem	6.6	6.6	-
Dropseed	6.3	5.9	> 0.500
Three-awn	15.1	27.2	< 0.001
Hairy grama	4.3	6.4	< 0.005
Fall witchgrass	5.2	3.5	< 0.050
Other	4.8	2.6	
Total Grasses	48.0	53.4	< 0.002
Shrubs			
Shinnery oak	49.8	43.1	< 0.001
Sandsage	1.0	0.9	
Yucca	0.8	1.6	
Mesquite	0.0	0.0	
Other	0.4	1.0	
Total Shrubs	52.0	46.6	< 0.002

[a]Six thousand four hundred data points from 32 transects.

[b]One thousand data points from 10 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 9. Percent basal composition of vegetation in subtype 1 versus that at winter foraging sites of lesser prairie chickens in subtype 1.

Species	Subtype 1 (6000)[a]	Winter (800)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	30.3	23.2	< 0.001
Little bluestem	5.9	7.9	< 0.050
Dropseed	3.8	7.0	< 0.001
Three-awn	8.6	13.0	< 0.001
Hairy grama	8.1	8.6	> 0.500
Fall witchgrass	5.1	6.8	< 0.050
Other	3.5	1.5	
Total Grasses	65.3	68.0	< 0.200
Shrubs			
Shinnery oak	32.7	28.9	< 0.050
Sandsage	0.6	0.8	
Yucca	0.8	1.8	
Mesquite	0.0	0.5	
Other	0.6	0.0	
Total Shrubs	34.7	32.0	< 0.200

[a]Six thousand data points from 30 transects.

[b]Eight hundred data points from 8 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 10. Percent basal composition of vegetation in subtype 2 versus that at winter foraging sites of lesser prairie chickens in subtype 2.

Species	Subtype 2 (12000)[a]	Winter (1900)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	9.6	4.9	< 0.001
Little bluestem	13.6	11.7	< 0.050
Dropseed	4.1	9.9	< 0.001
Three-awn	18.8	19.8	< 0.500
Hairy grama	7.5	4.2	< 0.001
Fall witchgrass	5.2	5.6	< 0.500
Other	6.5	4.7	
Total Grasses	65.3	60.8	< 0.001
Shrubs			
Shinnery oak	32.7	35.4	< 0.050
Sandsage	0.3	0.5	
Yucca	1.5	2.5	
Mesquite	0.0	0.4	
Other	0.2	0.4	
Total Shrubs	34.7	39.2	< 0.001

[a]Twelve thousand data points from 60 transects.

[b]One thousand nine hundred data points from 19 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 11. Percent basal composition of vegetation in subtype 3 versus that at winter foraging sites of lesser prairie chickens in subtype 3.

Species	Subtype 3 (6400)[a]	Winter (2300)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	5.7	2.9	< 0.001
Little bluestem	6.6	6.3	< 0.500
Dropseed	6.3	8.7	< 0.001
Three-awn	15.1	24.2	< 0.001
Hairy grama	4.3	6.6	< 0.001
Fall witchgrass	5.2	3.6	< 0.005
Other	4.8	2.0	
Total Grasses	48.0	54.3	< 0.001
Shrubs			
Shinnery oak	49.8	42.9	< 0.001
Sandsage	1.0	0.6	
Yucca	0.8	1.6	
Mesquite	0.0	0.3	
Other	0.4	0.3	
Total Shrubs	52.0	45.7	< 0.001

[a]Six thousand four hundred data points from 32 transects.

[b]Two thousand three hundred data points from 23 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Winter Foraging Sites Versus Subtype

In winter, the tendency to forage in relatively grassy areas was less evident than in fall (Tables 9, 10, and 11). Only in subtype three did the birds still clearly forage where there was more grass than in the overall subtype (Table 11, difference highly significant). In subtype one, total grass still appeared more abundant in foraging areas than in the overall subtype vegetation (Table 9), but the difference was not significant ($P < 0.2$). In subtype two, birds actually foraged where there was less total grass than in the overall subtype (Table 10, difference highly significant). Reasons for the shift to less grassy and, therefore, more brushy foraging sites in winter are given in the next section, which compares fall and winter foraging sites.

Fall Foraging Sites Versus Winter Foraging Sites

The most striking change in foraging sites from fall to winter was the greater proportion of shinnery oak at winter sites in subtypes one and two (Tables 12 and 13, differences highly significant). In conjunction with the increase in shinnery oak from fall to winter, there were highly significant increases in both litter and bare hits from fall to winter (Table 14), indicating a significant decrease in plant hits. This decrease in plant cover agrees with the increase in shinnery oak, as these shrubby areas tend to have a more open aspect.

Table 12. Percent basal composition of vegetation at fall and winter foraging sites of lesser prairie chickens in Shinnery Oak-Tallgrass subtype 1.

Species	Fall (700)[a]	Winter (800)[b]	P > |Z|[c]
	Mean	Mean	
Grasses			
Sand Bluestem	14.4	23.2	< 0.001
Little bluestem	7.4	7.9	> 0.500
Dropseed	12.3	7.0	< 0.001
Three-awn	18.7	13.0	< 0.010
Hairy grama	8.6	8.6	-
Fall witchgrass	9.3	6.8	< 0.100
Other	0.4	1.5	
Total Grasses	71.1	68.0	< 0.200
Shrubs			
Shinnery oak	21.9	28.9	< 0.010
Sandsage	1.9	0.8	
Yucca	2.7	1.8	
Mesquite	2.0	0.5	
Other	0.4	0.0	
Total Shrubs	28.9	32.0	< 0.200

[a]Seven hundred data points from 7 transects.

[b]Eight hundred data points from 8 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 13. Percent basal composition of vegetation at fall and winter foraging sites of lesser prairie chickens in Shinnery Oak-Tallgrass subtype 2.

Species	Fall (500)[a]	Winter (1900)[b]	P > |Z|[c]
	Mean	Mean	
Grasses			
Sand bluestem	7.6	4.9	< 0.020
Little bluestem	12.4	11.7	> 0.500
Dropseed	13.4	9.9	< 0.400
Three-awn	21.4	19.8	> 0.500
Hairy grama	8.8	4.2	< 0.001
Fall witchgrass	5.8	5.6	> 0.500
Other	2.8	4.7	
Total Grasses	72.2	60.8	< 0.001
Shrubs			
Shinnery oak	24.2	35.4	< 0.001
Sandsage	0.2	0.5	
Yucca	2.0	2.5	
Mesquite	0.0	0.4	
Other	1.4	0.4	
Total Shrubs	27.8	39.2	< 0.001

[a]Five hundred data points from 5 transects.

[b]One thousand nine hundred data points from 19 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 14. Percent total ground cover at fall and winter foraging sites (subtypes combined).

Item	Percent composition		
	Fall (23)[a]	Winter (51)[b]	$P > \|T\|$[c]
	Mean	Mean	
Litter	37.4	46.0	0.0028
Bare	37.4	44.3	0.0071
Plant	25.2	9.7	–[d]

[a]Number of foraging sites sampled in fall.

[b]Number of foraging sites sampled in winter.

[c]Probability of a Type I error.

[d]However, the difference is significant because there are significantly more litter and bare cover, and so there must be significantly less plant cover.

The increase in shinnery oak composition at winter foraging sites in subtypes one and two no doubt was due to the increased use of shinnery acorns for food in winter, as compared to fall (Table 2). As availability of insects and other food items decreases with the onset of cold weather, prairie chickens are forced to move onto another food source, acorns, in this case. Thus, prairie chickens move to denser areas of shinnery oak in winter to optimize foraging efforts and meet dietary needs.

The lack of movement to areas of greater abundance of shinnery oak in winter in subtype three (Table 15) is presumed to have been due to the high abundance of shinnery oak in this subtype (Appendix Table 25). The birds apparently were able to find shinnery in sufficient abundance for winter foraging needs without having to shift to areas where it was denser. This continued selection of relatively grassy sites for foraging in subtype three (the least grassy subtype) during winter further reinforces the suggestion that the birds were attracted to grass cover when shinnery was devoid of leaves. The birds left such cover only where they had to (in the grassier subtypes) in order to find sufficient shinnery for winter food needs.

Jones (1963) found that lesser prairie chickens in Oklahoma foraged in areas dominated by grass cover, mostly mid-grasses (side-oats grama, hairy grama, and windmill grass). Vegetation of his study area was quite different from that of the Shinnery Oak-Tallgrass type, but still had both shrub and grass components.

Table 15. Percent basal composition of vegetation at fall and winter foraging sites of lesser prairie chickens in Shinnery Oak-Tallgrass subtype 3.

Species	Fall (1000)[a]	Winter (2300)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	1.2	2.9	< 0.010
Little bluestem	6.6	6.3	> 0.500
Dropseed	5.9	8.7	< 0.010
Three-awn	27.2	24.2	< 0.100
Hairy grama	6.4	6.6	> 0.500
Fall witchgrass	3.5	3.6	> 0.500
Other	2.6	2.0	
Total Grasses	53.4	54.3	> 0.500
Shrubs			
Shinnery oak	43.1	42.9	> 0.500
Sandsage	0.9	0.6	
Yucca	1.6	1.6	
Mesquite	0.0	0.3	
Other	1.0	0.3	
Total Shrubs	46.6	45.7	> 0.500

[a]One thousand data points from 10 transects.

[b]Two thousand three hundred data points from 23 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

ROOSTING AND RESTING HABITAT

Data from daytime resting sites were pooled with those from nighttime roosting sites, as these two kinds of sites resembled each other in fall and winter too closely for consistent separation. Data from resting/roosting sites also were pooled for fall and winter, because the sample was too small for seasonal stratification.

Roosting/Resting Sites Versus Subtype

In subtypes one and three, total grass composition was greater (Tables 16 and 18, highly significant) at roosting/resting sites than in the overall subtype. No difference in total composition of either grasses or shrubs was seen between subtype two and roosting/resting sites (Table 17, $P < 0.5$). It is apparent, then, that roosting/resting sites were at least as high in grass composition as the overall subtype and that there is a strong indication (in two of three subtypes) of selection for roosting/resting sites which were grassier than the overall subtype. As in the case of fall foraging sites, and winter foraging sites in subtype three, the use of grassy sites for roosting/resting probably was due to selection of concealing cover.

Table 16. Percent basal composition of vegetation in subtype 1 versus that at roosting/resting sites of lesser prairie chickens in subtype 1.

Species	Subtype 1 (6000)[a]	Roosting/resting (640)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	30.3	33.5	< 0.100
Little bluestem	5.9	8.1	< 0.050
Dropseed	3.8	10.6	< 0.001
Three-awn	8.6	6.4	< 0.100
Hairy grama	8.1	8.5	> 0.500
Fall witchgrass	5.1	6.3	< 0.200
Other	3.5	0.2	
Total Grasses	65.3	73.6	< 0.001
Shrubs			
Shinnery oak	32.7	24.9	< 0.001
Sandsage	0.6	0.5	
Yucca	0.8	1.0	
Mesquite	0.0	0.0	
Other	0.6	0.0	
Total Shrubs	34.7	26.4	< 0.001

[a]Six thousand data points from 30 transects.

[b]Six hundred forty points from 8 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 17. Percent basal composition of vegetation in subtype 2 versus that at roosting/resting sites of lesser prairie chickens in subtype 2.

Species	Subtype 2 (12000)[a]	Roosting/resting (560)[b]	P > |Z|[c]
	Mean	Mean	
Grasses			
Sand bluestem	9.6	5.1	< 0.001
Little bluestem	13.6	10.9	< 0.100
Dropseed	4.1	8.9	< 0.001
Three-awn	18.8	16.0	< 0.100
Hairy grama	7.5	7.1	> 0.500
Fall witchgrass	5.2	12.4	< 0.001
Other	6.5	2.4	
Total Grasses	65.3	62.8	< 0.500
Shrubs			
Shinnery oak	32.7	34.3	> 0.500
Sandsage	0.3	0.9	
Yucca	1.5	2.0	
Mesquite	0.0	0.0	
Other	0.2	0.0	
Total Shrubs	34.7	37.2	< 0.500

[a]Twelve thousand data points from 60 transects.

[b]Five hundred sixty data points from 7 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 18. Percent basal composition of vegetation in subtype 3 versus that at roosting/resting sites of lesser prairie chickens in subtype 3.

Species	Subtype 3 (6400)[a]	Roosting/resting (480)[b]	P > |Z|[c]
	Mean	Mean	
Grasses			
Sand bluestem	5.7	1.7	< 0.001
Little bluestem	6.6	4.5	< 0.100
Dropseed	6.3	4.8	< 0.200
Three-awn	15.1	29.3	< 0.001
Hairy grama	4.3	13.7	< 0.001
Fall witchgrass	5.2	3.5	< 0.200
Other	4.8	1.5	
Total Grasses	48.0	59.0	< 0.001
Shrubs			
Shinnery oak	49.8	39.2	< 0.001
Sandsage	1.0	0.8	
Yucca	0.8	1.0	
Mesquite	0.0	0.0	
Other	0.4	0.0	
Total Shrubs	52.0	41.0	< 0.001

[a]Six thousand four hundred data points from 32 transects.

[b]Four hundred eighty data points from six transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Roosting/Resting Sites Versus Foraging Sites

Comparison of roosting/resting sites with foraging sites shows considerable similarity (Tables 19, 20, and 21). Both groups of data show dominance of grasses, with individual species varying among subtypes, and important smaller amounts of shrubs, especially shinnery oak. This similarity suggests that prairie chickens rested and roosted near their foraging areas, and is in agreement with field observations. There is, also, an indication that the birds sought more grassy sites for resting and roosting than for foraging in subtypes one ($P < 0.10$) and three (difference highly significant).

The importance of grassy cover for roosting/resting appears to be considerable when it is noted that the tendency is to use cover which is more grassy than that at foraging sites, which previously were shown to be more grassy than the overall subtypes except where the need for winter food was paramount.

The birds select a small patch of bare or litter-covered sand rather than a clump of grass or other vegetation on which to sleep. Thus, they rely on surrounding vegetation to provide protection and concealment. They may sleep in localized open spots to detect approaching predators and to provide easy, unobstructed flight for escape, but rely on nearby grasses for concealment. Shinnery oak loses its leaves in October, so grasses provide the bulk of the cover in fall and winter. Principal grasses which grow large

Table 19. Percent basal composition of vegetation at foraging sites and roosting/resting sites of lesser prairie chickens in Shinnery Oak-Tallgrass subtype 1.

Species	Foraging (1500)[a]	Roosting/resting (640)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	19.1	33.5	< 0.001
Little bluestem	7.7	8.1	< 0.050
Dropseed	9.5	10.6	> 0.500
Three-awn	15.7	6.4	< 0.001
Hairy grama	8.6	8.5	> 0.500
Fall witchgrass	7.7	6.3	< 0.300
Other	1.1	0.2	
Total Grasses	69.4	73.6	< 0.100
Shrubs			
Shinnery oak	25.6	24.9	> 0.500
Sandsage	1.3	0.5	
Yucca	2.2	1.0	
Mesquite	1.3	0.0	
Other	0.2	0.0	
Total Shrubs	30.6	26.4	< 0.100

[a]One thousand five hundred data points from 15 transects.

[b]Six hundred forty data points from 8 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 20. Percent basal composition of vegetation at foraging sites and roosting/resting sites of lesser prairie chickens in Shinnery Oak-Tallgrass subtype 2.

Species	Foraging (2400)[a]	Roosting/resting (560)[b]	P > |Z|[c]
	Mean	Mean	
Grasses			
Sand bluestem	5.4	5.1	> 0.500
Little bluestem	11.9	10.9	> 0.500
Dropseed	10.7	8.9	< 0.300
Three-awn	20.1	16.0	< 0.050
Hairy grama	5.1	7.1	< 0.100
Fall witchgrass	5.7	12.4	< 0.001
Other	4.3	2.4	
Total Grasses	63.2	62.8	> 0.500
Shrubs			
Shinnery oak	33.1	34.3	> 0.500
Sandsage	0.4	0.9	
Yucca	2.4	2.0	
Mesquite	0.3	0.0	
Other	0.6	0.0	
Total Shrubs	36.8	37.2	> 0.500

[a] Two thousand four hundred data points from 24 transects.

[b] Five hundred sixty data points from 7 transects.

[c] Probability of a Type I error (from Z statistic, after Lentner 1975).

Table 21. Percent basal composition of vegetation at foraging sites and roosting/resting sites of lesser prairie chickens in Shinnery Oak-Tallgrass subtype 3.

Species	Foraging (3300)[a]	Roosting/resting (480)[b]	$P > \|Z\|$[c]
	Mean	Mean	
Grasses			
Sand bluestem	2.4	1.7	< 0.500
Little bluestem	6.4	4.5	< 0.200
Dropseed	7.8	4.8	< 0.020
Three-awn	25.1	29.3	< 0.001
Hairy grama	6.6	13.7	< 0.001
Fall witchgrass	3.6	3.5	> 0.500
Other	2.2	1.5	
Total Grasses	54.1	59.0	< 0.050
Shrubs			
Shinnery oak	42.9	39.2	< 0.200
Sandsage	0.6	0.8	
Yucca	1.6	1.0	
Mesquite	0.2	0.0	
Other	0.6	0.0	
Total Shrubs	45.9	41.0	< 0.050

[a]Three thousand three hundred data points from 33 transects.

[b]Four hundred eighty data points from 6 transects.

[c]Probability of a Type I error (from Z statistic, after Lentner 1975).

enough to provide appreciable cover include sand bluestem, little bluestem, and dropseeds.

The limited data available on predation in fall and winter suggest that prairie chickens are vulnerable to predation while resting or roosting. During fall and winter of 1977-78, the known loss of radio-fitted birds to predation was 37.5 percent (three of eight birds) in a three-month period. Radio contact with the remaining five birds was lost, and it is assumed that at least some of these birds also were taken by predators. At that time, the study had been in progress during two previous spring-summer periods, and personnel were practiced at attaching radio transmitters. Further, the transmitters were designed to have minimum weight (13-19 g) and not to interfere with movements of birds carrying them. Therefore, it is assumed that the transmitters did not increase the birds' susceptibility to predation. All three predator-killed birds were found adjacent to fresh roosting/resting sites. It is possible that this high rate of predation on roosting/resting sites was due to a relative scarcity of taller grasses for use as cover. Two of the three known losses to predation occurred in subtype three (the least grassy subtype), and one occurred on a relatively brushy site within subtype two.

Jones (1963) found night roosts of lesser prairie chickens in Oklahoma to be small pockets of short vegetation located within areas of taller vegetation. Jones' findings are comparable to

those of this study and further demonstrate the use of surrounding tall vegetation for concealment and protection while roosting.

FALL LEK ACTIVITY

Full-time field work was conducted during fall of 1977. During this period, trapping and observation of the leks was conducted. Fall display activities occurred from late September through October.

In general, daily display activities were shorter in daily duration and less intense in fall than in spring. Birds arrived on the lek near sunrise and stayed for a maximum of one hour after sunrise. Little display activity was seen in evenings. Numbers of birds generally were higher on leks in fall than in spring, no doubt due to presence of young of the year. Most leks used were the same as those used in the spring. Some major spring leks, however, were not used, and others were used in fall but not in spring. Leks were mostly Shortgrass-Mesquite areas, but caliche oil pads, bare sand dunes, and sacrifice areas surrounding cattle watering-tanks also were utilized.

Lek activity was less intense in fall than in spring, and territories were seldom created or rigidly defended. Often, groups of birds, probably juvenile males, wandered around the lek displaying sporadically. Hens were not observed on leks in the fall. Birds typically flew into the periphery of the lek and then walked to the center. Any disturbance flushing the chickens off the lek ended display activity for that day; birds did not return to the lek the same morning. Principal disturbance on the leks

was by hawks that flew low over the lek and sometimes harassed prairie chickens. Similar observations for greater prairie chickens are well documented (Berger et al. 1963, Lehmann 1941, Schwartz 1945). Large numbers of hawks, particularly marsh hawks, were in the area at this time due to fall migration. Of three observed attacks on prairie chickens by marsh hawks, none was successful. Hawks are not believed to be serious predators of lesser prairie chickens on leks.

Regular displaying ceased on 31 October 1977. On that night, temperatures dropped to below freezing and were accompanied by high winds (about 35 mph). This weather continued the next day, accompanied by overcast skies. An abrupt end of fall lek activity by lesser prairie chickens also was observed by Copelin (1963). He indicated that it was associated with the first severe cold weather accompanied by snow or heavy clouds. On 28 and 29 October 1978, two leks were checked, but no birds were present. Local residents reported that weather similar to that which ended lek activity in fall 1977 had occurred several days previously.

Any census work conducted on lesser prairie chicken leks in fall should be begun by the second week of October. At this time, numbers were most stable and activity was at its peak. After this, there is considerable possibility of display activity on leks being curtailed by weather.

FLOCK SIZE

Information on fall and winter flock size of prairie chickens is scant. Lehmann (1941) reported that, in Attwater's greater prairie chicken, flocks became common in fall after cool weather began. He reported November flocks of generally four to twelve birds each, with large flocks increasingly common from early December to the onset of breeding in spring. He also mentioned flocks (reported to him) of up to 300 individuals in late winter. Although flocks of 25-30 were not uncommon in the winter, small groups of eight or fewer, and singles, were always to be found. Jones (1963) found that lesser prairie chickens did not form large flocks in the winter as did greater prairie chickens.

Flock size of lesser prairie chickens in southeast New Mexico was examined in the fall and winter of 1977-1978. Each time a flock or single chicken was observed, its location and numbers were recorded. Display on the fall lek grounds ended abruptly on 31 October. The flock record was then kept from 1 November through the end of February, when spring lek activity was starting.

Flock size was examined both by average flock size and typical flock size, average flock size being the total number of birds seen divided by the total number of flocks. Computing typical flock size is a method of reflecting the size group that the individuals most commonly found themselves in (Jarman 1973).

Both average and typical flock size decreased gradually from November through February (Table 22). In November, average flock size was 7.9 birds, while typical flock size was 17.0. In February, average flock size had decreased to 1.9, and typical flock size had decreased to 2.2.

Table 22. Fall and winter flock size of lesser prairie chickens in southeastern New Mexico.

Month	Average flock size	Typical flock size[a]	Range
November	7.9	17.0	1-24
December	7.2	10.9	1-20
January	3.8	7.5	1-19
February	1.9	2.2	1- 8

[a]Reflects the size of group in which most individuals find themselves; determined by adding up the flock size in which each individual finds itself, and dividing by the total number of birds seen (Jarman 1973).

MANAGEMENT CONSIDERATIONS

Subtype one of Shinnery Oak-Tallgrass was found to support denser populations of lesser prairie chickens than other subtypes and types. In order to increase the amount of subtype one present, several management practices may be used. In subtype two, it would be necessary to decrease the overall grazing pressure by reducing in numbers of livestock or by use of a proven, specialized grazing system. So long as the management practice resulted in denser tall grass cover, particularly of sand bluestem, the method is not critical.

In subtype three, due to the high composition of shinnery oak, it may be necessary to promote regrowth of grasses, by reducing abundance of shinnery. In this case, only partial kills should be carried out. Grazing levels should be reduced to levels of subtype one or lower. Shinnery oak supplies a large portion of the fall and winter diet of the lesser prairie chicken. Therefore, widespread, almost total eradication of shinnery would result in a decrease of food supplies. Boo and Pettit (1975) concluded that shinnery oak is important as a forage source for both livestock and wildlife most of the year, and as protection against sand-dune formation.

Mesquite-Shortgrass areas lack the potential to become Shinnery Oak-Tallgrasses, so management practices for prairie

chickens are not necessary on these areas. Mesquite-Shortgrass areas are important in their present condition as lek sites.

The high predation rate of radio-equipped birds suggests that grass cover for roosting and resting may be inadequate, especially in subtype three. Again, this cover can best be improved through better grazing management.

Grazing is not unnatural, as the grassland community evolved under some periodic grazing pressure from large herbivores (bison, pronghorn, and deer). But man has divided and fenced the grasslands, subjecting them to yearlong, intensive grazing by livestock. Grazing should not be eliminated as it is a part of the ecosystem, but should be carefully controlled.

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APPENDIX A

SCIENTIFIC AND COMMON NAMES OF PLANTS AND ANIMALS USED IN THIS REPORT

Table 23. Common names, orders, and families of animals used in this report, after Borror and White (1970).

Common name	Order	Family
Arachnids		
Spider	Araneida	Unidentified
Insects		
Ant	Hymenoptera	Formicidae
Caterpillar	Lepidoptera	Unidentified
Cricket	Orthoptera	Gryllidae
Ground beetle	Coleoptera	Carabidae
Long-horned grasshopper	Orthoptera	Tettigoniidae
Scentless plant bug	Hemiptera	Corizidae
Shield-backed bug	Hemiptera	Scutelleridae
Short-horned grasshopper	Orthoptera	Acrididae
Treehopper	Homoptera	Membracidae
Walking stick	Orthoptera	Ohasmatidae
Weevil	Coleoptera	Curculiondae

Table 24. Common and scientific names of plants mentioned in this report, after Correll and Johnston (1970).

Common name	Scientific name
Bitterweed	*Hymenoxys* spp.
Blue grama	*Bouteloua gracilis*
Broom groundsel	*Senecio spartioides*
Broom snakeweed	*Xanthocephalum sarothrae*
Buckley penstomen	*Penstemon buckelyi*
Buffalograss	*Buchloe dactyloides*
Croton	*Croton* spp.
Dropseed	*Sporobolus* spp.
Dwarf dalea	*Dalea nana*
Evening primrose	*Oenothera* sp.
Fall witchgrass	*Cognata lenitoloma*
False buffalograss	*Munroa squarrosa*
Hairy grama	*Bouteloua hirsuta*
Hall's panicum	*Panicum hallii*
Little bluestem	*Schizachyrium scoparium*
Mesquite	*Prosopis glandulosa*
Narrowleaf gromwell	*Lithospermum incisum*
Paspalum	*Paspalum ciliatifolium*
Phlox	*Phlox* sp.
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Sand bluestem	*Andropogon hallii*
Sand dropseed	*Sporobolus cryptandrus*
Sand lovegrass	*Erogrostis trichodes*
Sand sagebrush	*Artemisia filifolia*
Shinnery oak	*Quercus havardii*
Sideoats grama	*Bouteloua curtipendula*
Snakeweed	*Xanthocephalum* spp.
Spectacle pod	*Dithyraea wislizeni*
Spurge (Euphorbia)	*Euphorbia* spp.
Three-awn	*Aristida* spp.
Wildbuckwheat	*Eriogonum annum*
Windmill grass	*Chloris verticillata*
Yucca	*Yucca* sp.

APPENDIX B

BASAL COMPOSITION AND GROUND COVER OF VEGETATION TYPES AND SUBTYPES

Table 25. Percent basal composition of grasses and shrubs in the Shinnery Oak-Tallgrass subtypes.[a]

Species	Percent composition					
	Subtype 1 (30)[b]		Subtype 2 (60)		Subtype 3 (32)	
	Mean	SD	Mean	SD	Mean	SD
Grasses						
Sand bluestem	30.3	8.4	9.6	3.8	5.7	4.1
Three-awn	8.6	5.1	18.8	5.0	15.1	6.3
Hairy grama	8.1	5.0	7.5	3.4	4.3	3.6
Little bluestem	5.9	4.3	13.6	4.4	6.6	4.4
Hall's panicum	5.1	3.9	5.2	2.9	5.2	3.9
Dropseed	3.8	3.5	4.1	2.6	6.3	4.3
Sand lovegrass	1.6	-	3.6	-	1.0	-
Paspalum	0.7	-	1.8	-	2.2	-
False buffalograss	0.7	-	0.8	-	1.2	-
Others	0.5	-	0.3	-	0.4	-
Total Grasses	65.3	8.7	65.3	6.1	48.0	8.8
Shrubs						
Shinnery oak	32.7	8.6	32.7	6.1	49.8	8.8
Yucca	0.8	-	1.5	-	0.8	-
Sand sagebrush	0.6	-	0.3	-	1.0	-
Others	0.6	-	0.2	-	0.4	-
Total Shrubs	34.7	8.7	34.7	6.1	52.0	8.8

[a]From Riley (1978).

[b]Number of transects in each subtype.

Table 26. Percent basal composition of vegetation in the Mesquite-Shortgrass type.[a]

Species	Percent composition	
	Mean	SD
Grasses		
Blue grama	63.5	16.4
Buffalograss	15.9	20.2
Three-awn	6.0	8.0
Dropseed	2.8	4.0
Sideoats grama	0.6	1.4
Others	0.3	-
Total Grasses	89.1	-
Shrubs		
Broom snakeweed	5.5	7.6
Others	0.6	-
Total Shrubs	6.1	-
Forbs		
Croton	1.4	1.9
Unclassified forbs	3.4	4.0
Others	T[b]	-
Total Forbs	4.8	-

[a]From Riley (1978).

[b]Less than 0.5 percent.

Table 27. Percent total ground cover in the Shinnery Oak-Tallgrass and Mesquite-Shortgrass vegetation types.[a]

Types/subtypes	Plant		Litter		Bare	
	Mean	SD	Mean	SD	Mean	SD
Shinnery Oak-Tallgrass						
Subtype 1 (30)[b]	18.8	7.1	42.9	9.0	38.3	8.9
Subtype 2 (60)	11.7	4.1	32.8	6.1	55.5	6.4
Subtype 3 (32)	9.2	2.5	31.7	8.3	59.1	8.7
Mesquite-Shortgrass (30)	26.3	2.1	19.4	11.1	54.1	9.2

[a]From Riley (1978).

[b]Number of transects in each type/subtype.