THE HABITAT OF THE SCALED QUAIL (*CALLIPEPLA SQUAMATA*) (VIGORS) IN THE OKLAHOMA PANHANDLE

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INTRODUCTION

At present, there is only a general knowledge of the composition of the habitat used by many game birds. A more adequate understanding and description of the habitat occupied by a species is necessary as a basis for developing a more purposeful habitat management program to maintain and increase existing populations.

The main purpose of this study was to define the habitat used by scaled quail, Callipepla squamata (Vigors), in western Oklahoma. The various binding influents of the habitat occupied by the birds in the three main vegetation types were investigated. Information was gathered on such environmental resources as food, shelter including nesting situations, and living space in terms of winter and summer homesteads.

Full-time field work was conducted in Cimarron County, Oklahoma, during the period from June, 1954, to September, 1955. Several one-week to two-week trips were taken in 1955 and 1956 to the study locale to recheck and expand upon previous observations. Altogether, approximately 18 months were spent in field studies.

METHODS OF INVESTIGATION

Traps, Trapping, and Marking Technique

A drive trap described by Ligon (1946) accounted for 800 of 1,200 scaled and bobwhite quail trapped during the period of February, 1954, to June, 1956. Two slight modifications in trap design were made to render the trap more efficient. Rolls of one-inch mesh chicken wire, 150 feet long and 12 inches wide, were found to be more suitable for the wings of the traps than wings of twine mesh. These wire wings could be fastened in place with metal stakes in a short time. Fewer quail escaped by crawling under spaces at the base of the wings.

A holding cage of wire, 3' x 3' x 6", attached to the smaller end of the funnel, was an aid during the trapping operation. This case eliminated the problem, when attempting to trap a large covey, of having the first arrivals at the trap return to the entrance of the funnel. As soon as the last quail was seen to enter the trap, it was essential to close the entrance quickly to prevent any quail from leaving. Camouflaging the mouth of the funnel with weeds or brush was helpful.

A main problem in quail trapping with a drive trap was determining the route the quail covey most likely would take

upon being disturbed. Fence rows, junk piles, farm implements, and shelterbelts provided successful drive trapping situations. Success was increased when the trap was set near an area where quail gathered for resting and dusting. If the quail were forced to run across a large area before reaching the trap wings, they tended to scatter and flush wildly. Although Ligon (1946) suggested additional manpower, trapping by one individual on foot was performed satisfactorily.

Often two or three trappings were made at the same trap site during a day. While one group of trapped quail was being banded and marked, the untrapped individuals of the covey drifted back to their resting site.

Several types of bait-traps were employed successfully to capture scaled and an occasional bobwhite quail including a conventional Stoddard funnel trap, a tunnel trap, and a ladder trap (Figure 1).

Standard size Number 7, $\frac{7}{32}$" inside diameter, aluminum leg bands were attached to all quail trapped. In addition, red plastic leg bands were placed on females and green on males.

The most successful marker used in this study was the harness type described by Blank and Ash (1956). This type of marker, using various colors and combinations of symbols, paints, and plastic materials, made it possible to recognize marked quail as individuals without recapturing them.

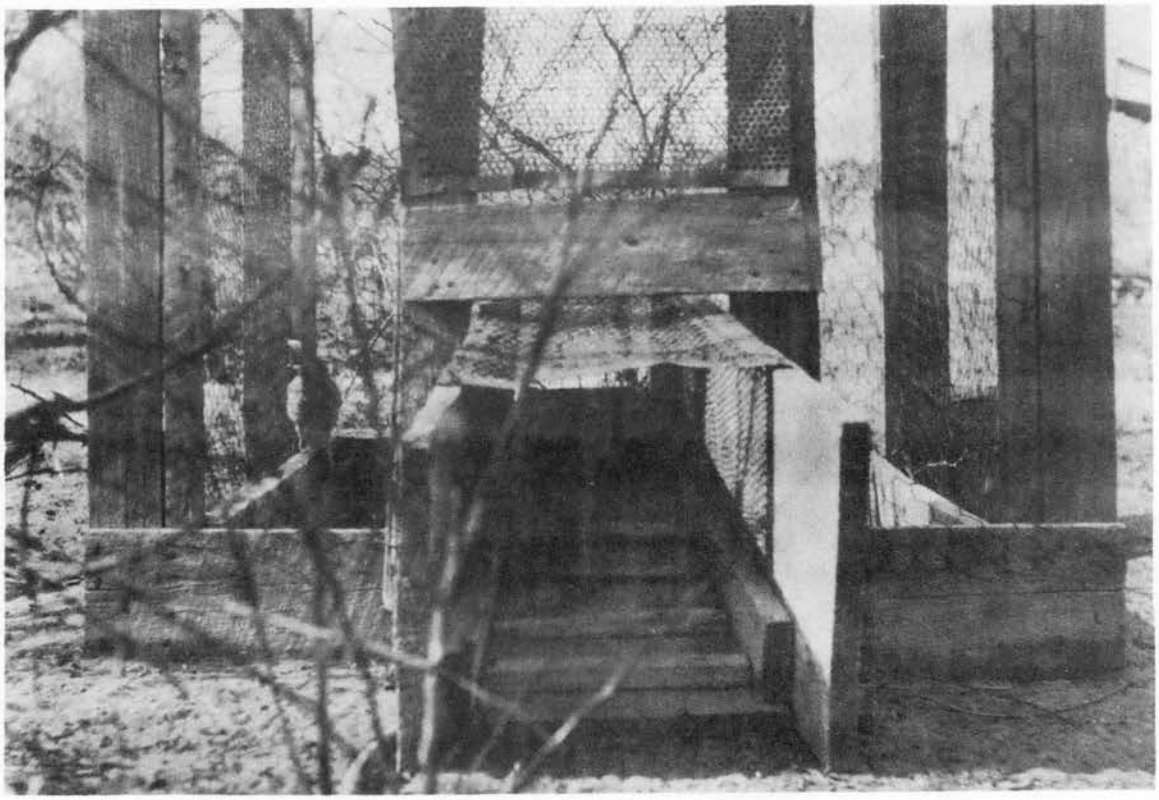


Figure 1.--Ladder trap effective for scaled and bobwhite quail, Cimarron County, Oklahoma, December, 1955.

Dyes of different colors were used on each study area to mark the plumage of immature quail. The procedure for dyeing outlined by Winston (1954) was followed. Plastic bowties (Wint, 1951) conforming in color to the dye in use on a particular study area were attached for more permanent marking. Small aluminum hog rings were found to be more suitable than surgical clips for attaching bowties.

Sex and Age Determination

The male of scaled quail can be distinguished from the female during the spring and summer by the brighter blue plumage of its head and neck. The female, as a rule, has a drabber brownish-blue plumage coloration. Sex and age ratio data were obtained from heads (Figure 2) and wing tips (Figure 3) contributed by sportsmen. Quail heads were stored in formalin-filled jars until examined. Morphological characteristics used to determine sex and age of scaled quail were those described by Wallmo (1956b).

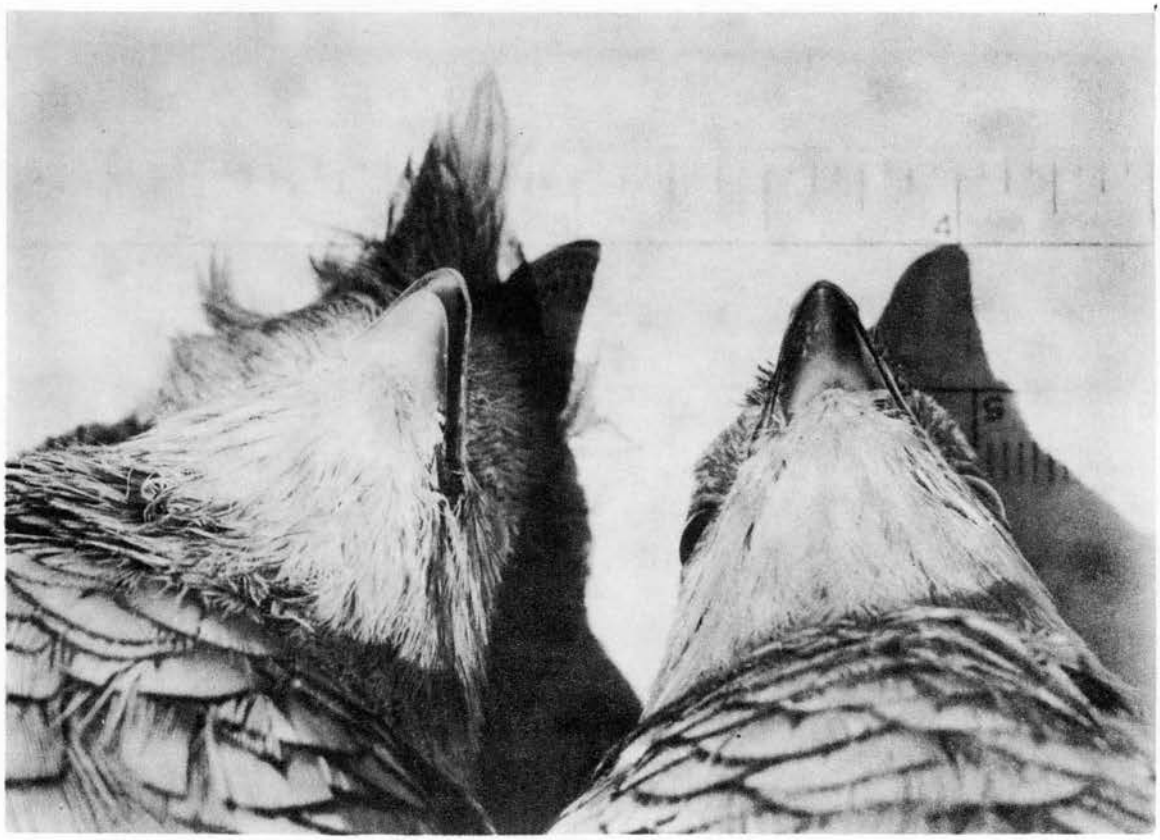


Figure 2.--Female (left) and male scaled quail showing the difference in throat region plumage. Note the streaks on the throat of the female.

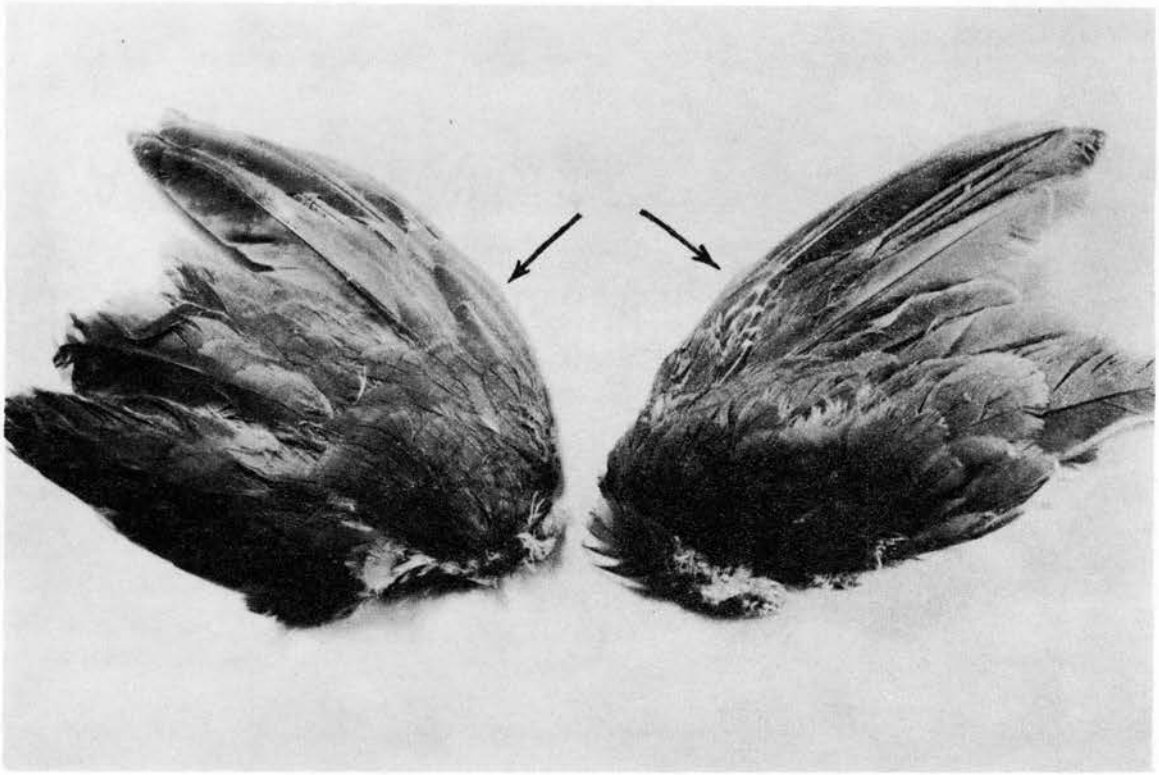


Figure 3.--Scaled quail wings illustrating age characteristics. Solid gray coverts on the left indicate an adult quail, older than 14 months. Mottled coverts of right wing indicate a juvenile bird of the year.

Field Observations

Conventional field observation methods were employed. Observations were made from horseback during the latter stage of this study. This allowed a more thorough coverage of the study area in a shorter time than was previously possible while on foot. Windmills also were used with success as observation towers. Useful aids in locating quail were tracks, carcasses, feathers, and dropping accumulations as

well as calls by the birds. The activities of each group of quail were recorded at the time of observation.

Food Studies

Most of the quail crops obtained during this study were made available by hunters. Since samples were taken during a period of six weeks, the analyses of crops collected portray only the early winter period. Field collections of seeds from plants growing in quail habitat were made to facilitate later identification of food materials found in crops. Records were made of quail feeding behavior whenever possible.

The crops were segregated into three groups according to the vegetation type in which the quail were killed. Conventional techniques of crop analysis were employed in accord with Martin (1949). Volumes of dry foods were measured to 0.1 cubic centimeters with lesser items recorded as traces.

GENERAL DESCRIPTION OF THE STUDY AREA

Natural Features

Climate

An important environmental factor in western Oklahoma, as elsewhere, is climate. The climate of the region is of the continental semi-arid type, characterized by hot summers and relatively mild winters. The open Oklahoma Panhandle plains of 4,000 to nearly 5,000 feet altitude are less subjected to the warm moist winds from the Gulf of Mexico and are, therefore, cooler and drier than those eastward in Oklahoma.

The daytime summer temperatures are usually high, but the nights usually are comfortably cool. The hot, dry winds during the spring and summer months contribute to increased rates of evaporation and of transpiration, thereby reducing the effectiveness of the total annual precipitation to vegetation.

The prevailing winds blow from a southerly and southwesterly direction throughout the year. Dust storms are moderate to severe, especially in February and March.

A particularly damaging dust storm accompanied by 60 to 85 mile-per-hour winds occurred on February 19, 1954. Mr. Orville Embry, who farms six miles north of Boise City,

reported finding 11 scaled quail in one group dead apparently from dust asphyxiation. The quail were discovered after the storm in a wheat field adjacent to his home. Carhart (1954) also mentioned quail in his list of victims during this same storm period in southeastern Colorado.

The mean annual temperature at Boise City, Oklahoma, over a recorded period of 48 years, was 54.4° F., and the mean annual temperature at Kenton, Oklahoma, for a 51 year period was 55.3° F. Peak annual temperatures are reached at Boise City during July when the average monthly temperature is 77.2° F. Warm summer temperatures prevailed at Boise City and Kenton during the period June-August, 1954, 1955, 1956, being 2½ degrees above average. January is usually the coldest month of the year with an average monthly temperature of 33.5° F. at Boise City. Winter temperatures were mild at Boise City and Kenton during the period November - March, 1954-1955 and 1955-1956, being two degrees above average.

The highest and lowest temperatures recorded at Boise City were 107° F. and -16° F., and at Kenton they were 108° F. and -22° F. The average frost free growing season is from April 20 to October 21, a period of 184 days at Boise City (U. S. Department of Commerce, 1954, 1955, 1956).

The average annual rainfall at Boise City and Kenton is 16.81 and 17.11 inches, respectively. Rainfall often comes as local thundershowers. Much of the rainfall from these

showers is lost as run-off. Rainfall during July, 1954, exemplifies the irregularity of the rainfall pattern within the county. Less than one inch of rain was recorded at Boise City, while during the same period 2.85 inches of moisture fell at Kenton, 28 miles away.

The average annual snowfall in the period from 1926 to 1955 was 21 inches at Boise City and 16.4 inches at Kenton (Murphy, 1957). One measure of the generally mild weather conditions during the winter of 1954-55 and 1955-56 was the general lack of snow. During the winter of 1954-55, only 4.25 inches of snow fell, or 77.3 percent below average. The 1955-56 winter snowfall at these two stations, 8.6 inches, was 54.0 percent less than average. Average temperatures during the period November-March, 1954-55 and 1955-56, were two degrees above average.

The period from 1954 to 1956 encompassed by this study included some of the most severe drought conditions on record. The 1956 annual precipitation total of 6.95 inches for Boise City was the lowest on record since 1908. Rainfall deficits below the average were: 1954, 32.4 percent; 1955, 36.7 percent; and 1956, 58.7 percent. The average rainfall deficit for the three year period was 42.6 percent. Drought conditions in January, 1956, were estimated to be of a severity expected only once in 140 years (United States Weather Bureau, 1956).

Vegetation

The vegetation of western Oklahoma has been classified in various categories by ecologists. Most ecologists have classified the Oklahoma Panhandle in the grassland formation (Shantz, 1911, Clements, 1920, Blair and Hubbell, 1938, Weaver and Clements, 1938, and Carpenter, 1940). One of the most detailed maps and comprehensive descriptions of Cimarron County vegetation has been compiled by Duck and Fletcher (1943 and ca. 1944). The vegetation types listed by Duck and Fletcher (Table 1) were similar to the vegetation descriptions of biotic districts by Blair and Hubbell (1938).

Table 1. Approximate Area in Square Miles Occupied by Major Vegetation Types in the Oklahoma Panhandle Counties (from Duck and Fletcher, ca. 1944)

County	Short Grass	Sandsage	Bottom-land	Pinyon-Juniper	Total Area
Cimarron	1,127	282	79	355	1,843
Texas	1,690	301	73	---	2,064
Beaver	1,475	267	68	---	1,810

Short Grass.--The short grass-high plains of Duck and Fletcher (1943) essentially coincide with the short-grass plains (Bulbilis-Bouteloua) association of Bruner (1931). Cimarron County is part of the High Plains section of the Great Plains Province (Fenneman, 1931). This broad, gently undulating plain supporting the short-grass vegetation type

slopes downward slightly to the east with an average elevation of 4,000 feet. Most of the short-grass plains is extremely flat and almost unaffected by water erosion. Nearly 65 percent of the High Plains has no surface drainage (Schoff and Stovall, 1943). This relatively flat plain is dissected by several short tributaries of the Cimarron River. The soils of this type are sand and clay loams which are fine textured, tight, and compact, but deep and fertile.

The characteristic short grasses of this vegetation type are blue grama (Bouteloua gracilis) and buffalo grass (Buchloe dactyloides) which form an open, mat-like sod cover. Western wheatgrass (Agropyron smithii) grows in the lower, moist places often adjacent to large, saucer-like depressions called playas. Other common grasses are side-oats grama (Bouteloua curtipendula), red three-awn (Aristida longiseta), purple three-awn (A. purpurea), and ringgrass (Muhlenbergia torreyi).

Scattered clumps of soapweed (Yucca glauca) and prickly pear (Opuntia spp.) were widely distributed over much of the short-grass type. Skunkbush (Rhus trilobata), wild currant (Ribes odoratum), and wild grape (Vitis sp.) grow along the rocky draws. Prevalent short-grass type forbs include: broad-leaved milkweed (Asclepias latifolia), wavy-leaved thistle (Cirsium undulatum), snow-on-the-mountain (Euphorbia marginata), broomweed (Gutierrezia sarothrae), blazing star (Liatris punctata), tooth-leaved primrose (Oenothera

serrulata), purple prairie clover (Petalostemum purpureum), few-flowered psoralea (Psoralea tenuiflora), and prairie zinnia (Zinnia grandiflora).

Sandsage-Grassland.--The main physiographical feature of this type is the rolling, dune-like topography. These sand dunes often form on the leeward side of the beds of intermittent water flows.

Sandsage (Artemisia filifolia) and soapweed are low-growing shrubs that are widely and uniformly distributed in this type. Skunkbush and sand plum (Prunus watsonii) are shrubs with a more restricted distribution.

An assortment of tall, "mid," and short grasses are found associated with the shrubs. Sand bluestem (Andropogon hallii), big sand grass (Calomovilfa gigantea), switch grass (Panicum virgatum), and needle and thread grass (Stipa comata) are the main tall grasses. "Mid" grasses include sand dropseed (Sporobolus cryptandrus) and sandbur (Cenchrus pauciflorus). False buffalo grass (Munroa squarrosa), sand paspalum (Paspalum stramineum), and blue grama compose the main short grasses.

Some of the more common forbs are pigweed (Amaranthus spp.), western ragweed (Ambrosia psilostachya), Texas croton (Croton texensis), jimson weed (Datura stramonium), annual eriogonum (Eriogonum annuum), sand lily (Mentzelia stricta), buffalo bur (Solanum rostratum), and Russian thistle (Salsola pestifer).

The soils of the sandsage-grassland are of a calcareous, deep sandy, well-drained nature often underlain by a granular, permeable, calcareous subsoil of sand or clay loam.

Pinyon-Juniper Vegetation Type.--Mesa de Maya of Blair and Hubbell (1948) and the pinyon-juniper type of Duck and Fletcher generally coincide in area and location in northwestern Cimarron County. The variable physiographic character of this type includes flat-topped, steep-sided rocky mesas (Figure 4), bluffs, and low hills separated by canyons which lead into the relatively flat valley floor of the Cimarron River.

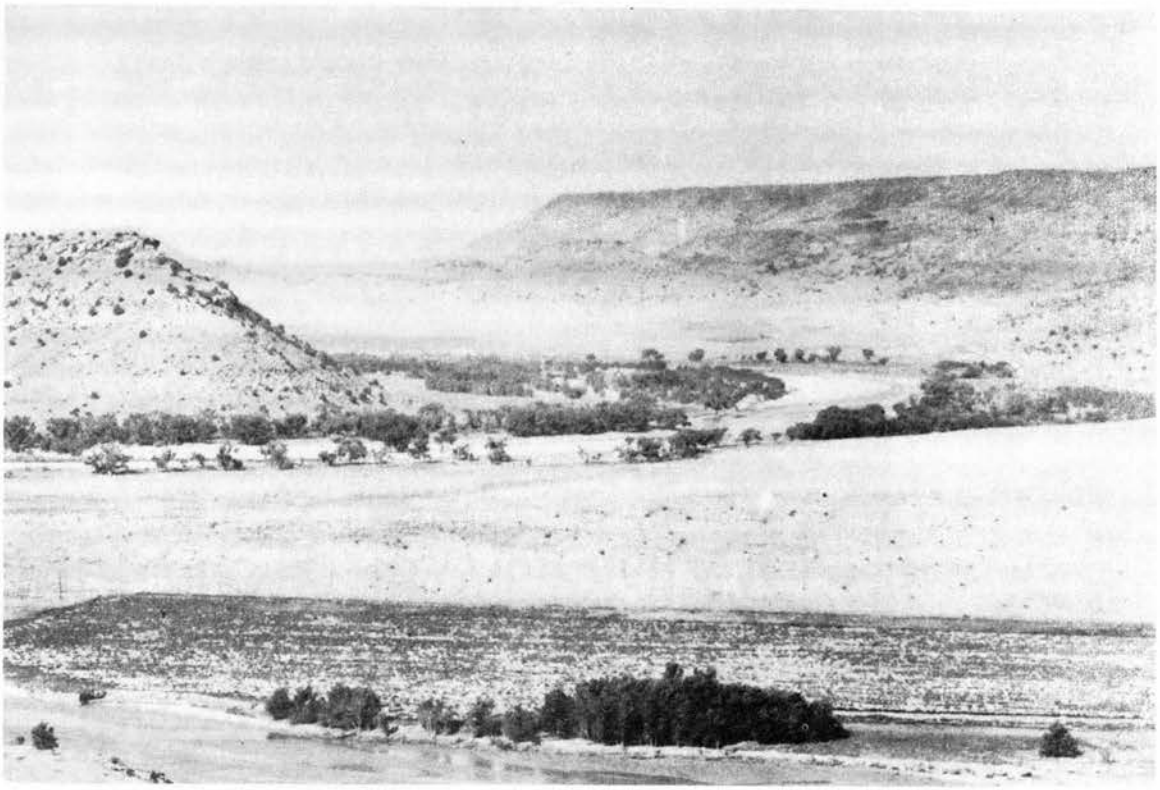


Figure 4.--View of Black Mesa in the background and the flood-plain of the Cimarron River in the foreground, three miles east and one mile north of Kenton, Oklahoma, Cimarron County, April, 1955.

Associated with this diverse topography is a wide variety of plant species. Blair and Hubbell (1938) recognized that the vegetation of this type was part of a transitional area with marked southern Rocky Mountain foothill as well as short-grass plains affinities.

The canyon floors are characterized by dense growths of tree cactus (Opuntia imbricata) in association with an occasional mesquite (Prosopis glandulosa) and scattered patches of rabbit brush (Chrysothamnus nauseosus). Common grasses intermingled with the shrubs are galleta grass (Hilaria jamesii), hairy grama (Bouteloua hirsuta), black grama (B. eriopoda), and blue grama. Representative forb components of the flora on the tree cactus canyon floor are bee flower (Cleome serrulata), gumweed (Grindelia squarrosa), wooly white (Hymenopappus sp.), bush morning glory (Ipomoea leptophylla), Riddell's groundsel (Senecio riddellii), toothed euphorbia (Euphorbia dentata), and few-flowered psoralea.

The mesa slopes and ledges are covered with thickets of low, shrub-like growth averaging four to 10 feet in height. The main components of this shrub growth are white juniper (Juniperus monosperma), thick-leaved hackberry (Celtis reticulata), mountain mahogany (Cercocarpus montanus), oak (Quercus gambellii), and skunkbush. Pinyon pine (Pinus edulis) occasionally is found growing in close association with juniper on north-facing slopes. Tall grasses such as

big bluestem (Andropogon gerardi), little bluestem (A. scoparius), Indian grass (Sorghastrum nutans), cottontop (Trichachne californica), and plains bristlegrass (Setaria macrostachya) grow intermingled among the shrubs on the steep, sandstone talus slopes.

The flat-topped mesas are covered with dense growths of white juniper. In the understory are black, blue, and sideoats grama grass.

The soils of the pinyon-juniper vegetation type vary from fine loam to coarse gravel. Some of the soils are shallow while others are deep.

Land Use Characteristics

Widespread cultivation in Cimarron County began about 1900. By 1910 (Table 2), 10 percent of the county (approximately 118,000 acres) was in cropland (Bureau of Census, 1913). During the period 1925 to 1931, favorable rainfall encouraged the plowing of considerable acreages of rangeland which were planted primarily to wheat (Ott, 1956).

The period 1931 to 1938 was characterized by low rainfall, crop failure, wind erosion, and land abandonment (Soil Conservation Service, 1955). Most of the land that failed was poor, sandy land unfit for sustained wheat production (Finnell, 1949). At the peak of the drought in 1938, only 8,200 acres of wheat were planted compared to 305,000 in 1931.

Table 2. Acreage in Cropland, Number of Farms, and Average Size of Farms in Cimarron County, Oklahoma (from Bureau of Census, 1913, 1922, 1932, 1942, 1946, 1952, 1956)

Year	Acres of Cropland	Number of Farms	Average Size of Farm
1910	117,828	1,307	------*
1920	97,179	767	------
1925	148,319	761	------
1930	315,513	887	1,203.5
1935	425,595	975	1,306.2
1940	315,767	605	1,536.3
1945	396,324	560	1,847.4
1950	443,386	616	1,788.0
1954	443,156	559	1,962.8

*Data not available

The weather pattern changed from dry to wet during the period 1942 to 1951 (Murphy, 1957). Again, large acreages of grassland were plowed for crop production (Figure 5). The Soil Conservation Service (1955) estimated that three out of the four million acres plowed up in the Southern Plains between 1942 and 1952 were not suitable for permanent cultivation. During the period 1940 to 1955, 127,389 acres in Cimarron County have been returned to cultivation (Bureau of Census, 1956).

Figure 5.--Soapweeds persisting on plowed-up sandy grassland planted to sudan grass ten miles west of Boise City, NE¼, NE¼, Section 24, T3N, R3E, Cimarron County, Oklahoma, December, 1955.

The general trend in Cimarron County is toward increased acreages in cropland and larger farms. The pattern of land-use is portrayed in Figure 6.

Of the 1,172,480 acres in Cimarron County, 242,500 acres, 20.7 percent, are state-owned school lands. This acreage represents the largest county acreage of state-owned land in Oklahoma. Other public land includes 14,400 acres in the southwestern section of the county which are part of a Land Utilization Project administered at present by the

United States Forest Service. The majority of the public land in this area is used as rangeland.

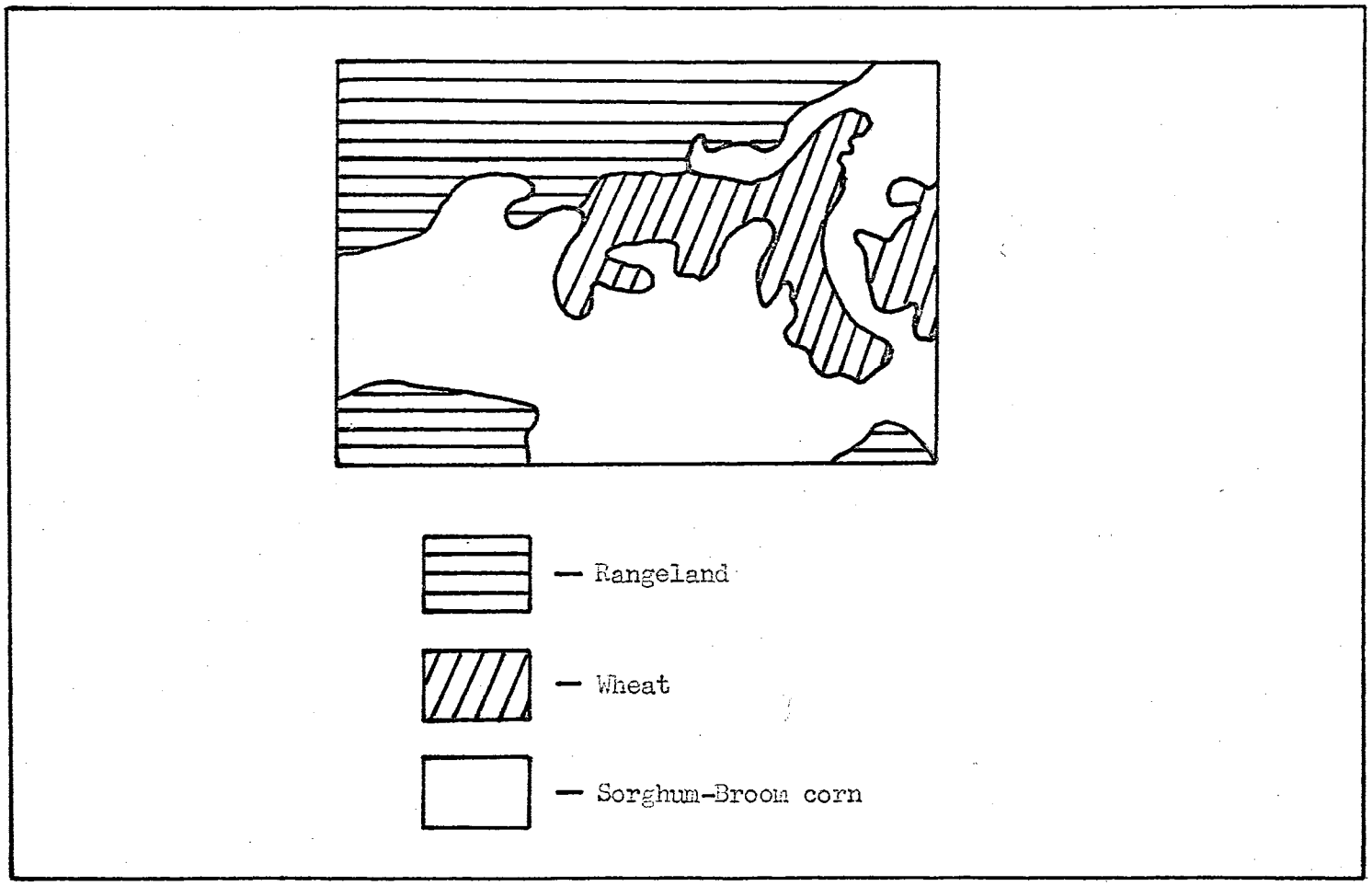


Figure 6.— Major land-use adaptation areas of Cimarron County (from Finnell, 1939).

RESULTS

Habitat-Use by Scaled Quail

Vegetation for Cover and Shelter

Seasonal Use.--A generalized description of the usual daily routine of scaled quail during the four main seasons of the year based on the observations of color-marked birds provides a basis for the understanding of more specific habitat-use relationships.

Winter

During the winter period, small groups of quail often were observed shortly after daybreak feeding among soapweeds or in soapweed-sandsage pastures, weed patches, or grain stubble fields as they made their way toward a resting area. In the early morning, quail also were seen near ranch buildings feeding with domestic poultry on scattered grain.

After the early morning feeding period, the birds retired to certain distinctive situations. Man-made structures, especially corrals (Figure 7), feedlots, buildings, farm implements (Figure 8), cattleguards, culverts, windmills, and piles of junk, posts, boards, or brush, were used as resting cover (Tables 8 and 9).

Figure 7. Feedlot and old corral used by scaled quail, Strong Ranch, 12 miles north of Boise City, Cimarron County, Oklahoma, April, 1954.

When scaled quail were disturbed at their resting site, they flew some 50 to 200 yards out into the adjacent soapweed or soapweed-sandsage grassland. Upon further pursuit by the observer, they flew or ran to the nearest skunkbush, currant, juniper, or cultural cover. Within a period of thirty minutes to an hour, some of the quail and often one-half or more of the covey had returned to the original flushing site at the covey resting area. Although the man-made structures served primarily as protective shelter, the vicinity often served as a feeding ground. Patches of food

plants, such as buffalo bur, croton, pigweed, and western ragweed usually were found growing about disturbed areas.

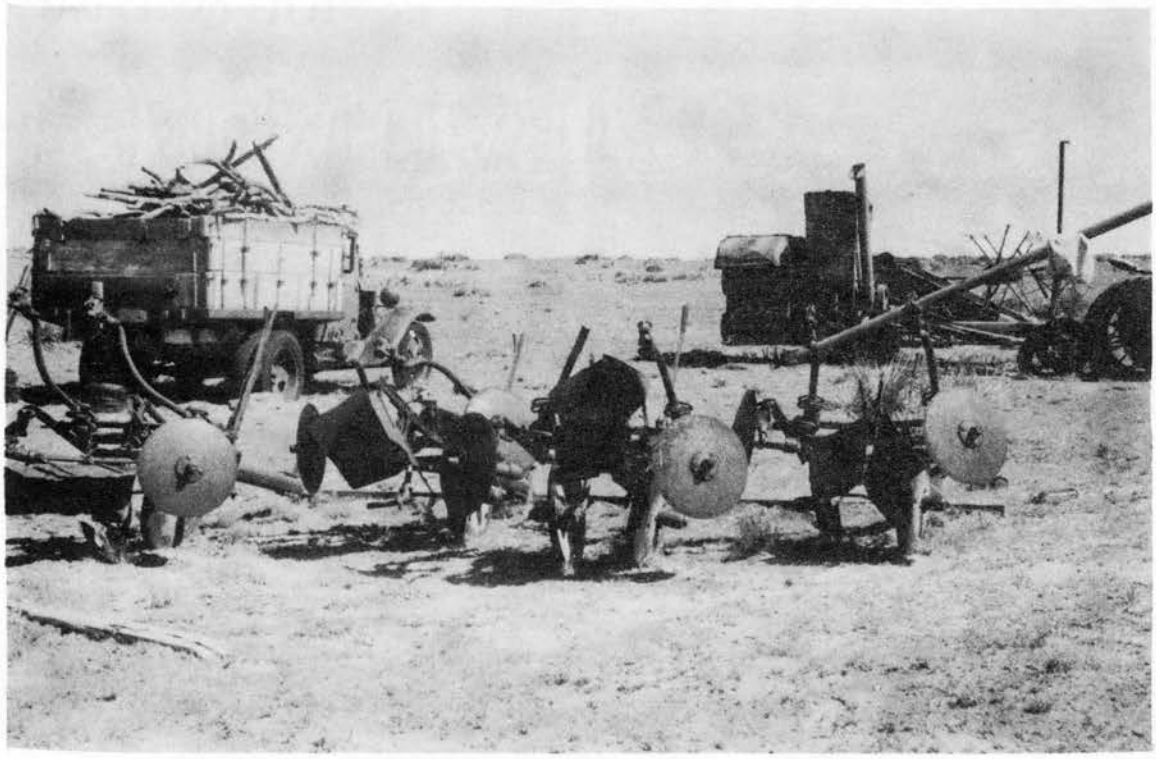


Figure 8.--Trapping Station 16 and scaled quail resting area, Elmer Williams Ranch, sandsage-grassland, 10 miles west of Boise City, Cimarron County, Oklahoma, June 8, 1956. Quail often rested in piles of posts on a truck, six feet off the ground.

Scaled quail in the pinyon-juniper vegetation type often rested during midday in the shade provided by the spiny branches of tree cactus (Figure 9 and Table 11). When flushed, they flew or ran from one tree cactus to another nearby tree cactus. When pressed, the quail sometimes temporarily left the tree cactus on the canyon floor and

flew or ran to shrub cover on the steep sides of a nearby mesa (Figure 10).

Figure 9.--Tree cactus adjacent to juniper and skunkbush covered hillside, Elzy Tanner Ranch, pinyon-juniper type, two miles east, three miles north of Kenton, Oklahoma, Cimarron County, April, 1956.

Figure 10.--Shrub growth of skunkbush, scrub oak, mountain mahogany, and juniper on steep slope, M. Roberts Ranch, pinyon-juniper type, three miles east, one mile north of Kenton, Oklahoma, Cimarron County, April, 1957.

A variety of vegetation and cultural situations providing overhead cover also were used by scaled quail for shelter from hawk molestation (Table 3). In 17 instances, hawks were observed to flush quail from rather open, exposed situations to more dense cover.

Spring

The large winter coveys usually began to separate into smaller groups during late March and April prior to the breeding season. During the spring months, March to May, scaled quail spread out from their winter headquarters to reinhabit areas having less cover.

Table 3. Protective Cover Made Use of by Scaled Quail to Avoid Hawks, Cimarron County, Oklahoma, 1954-1957

Date	Species of Hawk	Situation from which Hawk Flushed Quail	Escape Cover
8/19/54	Sparrow	Sparse soapweed	Young quail flew to dense soapweed
8/29/54	Marsh	Sandsage	Corral
9/5/54	Marsh	Soapweed	Corral
9/21/54	Marsh	Perched on a rock	Skunkbush
10/11/54	Marsh	Open short grass	Piled railroad rails
12/20/54	Marsh	Soapweed-sandsage	Farm implements
12/29/54	Marsh	Feedlot	Corral
12/31/54	Cooper's	Grain stubble	Shelterbelt
9/7/54	Marsh	Sunflower patch	Farm implements
4/22/55	Marsh	Open grassland	Junk pile
9/7/55	Marsh	Open pasture	Brush pile
9/10/55	Marsh	Feedlot	Wagon
11/27/55	Prairie falcon	Soapweed	Corral
8/22/56	Marsh	Open pasture	Farm implements
8/24/56	Marsh	Maize field	Junk pile
9/13/56	Marsh	Weeds	Farm implements
1/3/57	Marsh	Scattered soapweeds	Sand plum thicket

Soapweed clumps and sandsage were frequented for resting purposes more commonly during this period. Their use of open habitat during the spring and summer may have been attributable in part to a lower hawk and owl population during these seasons. Allan and Sime (1943) made seasonal censuses of hawks over a four-year period in the nearby Texas Panhandle. Their figures showed that hawk populations reached their peak in the fall and winter and were at a minimum in the spring and summer. The vegetative growth of annual forbs and annual and perennial grasses also provided widespread cover. This tendency toward a more uniform distribution of scaled quail was characteristic of the spring season.

Summer

During the early summer in June and July, the birds often were seen foraging in exposed areas, such as open grassland, which seldom were used during other seasons of the year. Winter headquarters then were occupied only by an occasional pair or by a whistling male. Beginning in August, many of the broods of chicks with their parents started to return to their winter headquarters site to rest in the shade and overhead protection of farm implements, junk piles, shelterbelts, and naturally growing groups of shrubs.

Large clumps of soapweed, where available, appeared to be particularly attractive for shade purposes. The dry,

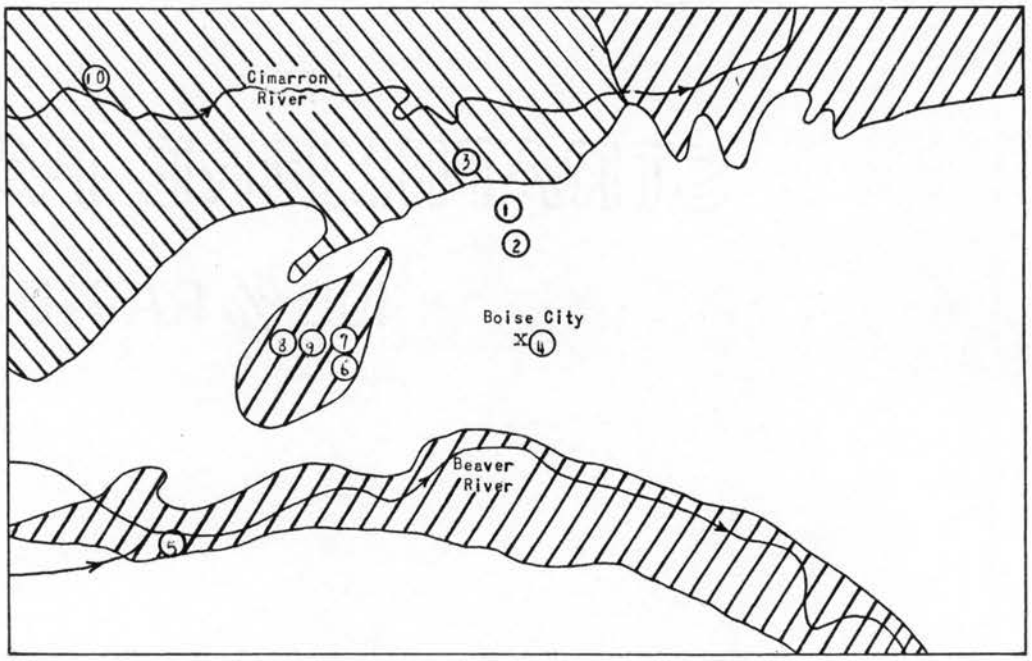
sandy, and loamy soils adjacent to soapweeds served ideally for dusting purposes.

Fall

Fall was a transition period when scaled quail continued and completed the move from their nesting and summer area to their winter locale. As previously mentioned, these two areas often partly overlapped.

An example of this pronounced movement was witnessed on the Sterling Graham study area in early September and October, 1954. This movement was directed toward a canyon heavily overgrown with skunkbush. Throughout the nesting season, from June to August, only three pairs of adults, each without a brood, were seen in the vicinity of this canyon. During the period from September 27 to October 13, 1954, 35 scaled quail were trapped and color-marked in this canyon area. An additional 25 quail, all unbanded, were observed in the vicinity.

Analysis of Winter Homesteads.--The boundaries of 10 homesteads were ascertained during the winter of 1954-1955. Four of these homesteads were re-examined during the winter of 1955-1956 and were found to be very similar in area and components. For present purposes, these areas will be called winter homesteads since complete annual homesteads for all 10 areas are unknown. The location of the study areas upon which these homesteads were studied is shown on Figure 11.



Legend:

Homestead Number	Study Area- Landowner's Name
1	Sterling Graham
2	South of Sterling Graham-Station 11
3	J. R. Eiland
4	Boise City- Dr. I. D. Alexander
5	J. G. Mayhan
6	L. J. Holloway
7	H. Barnes
8	E. Williams
9	E. Williams
10	E. Tanner

Scale 1"= 5.5 miles

Short grass

Pinyon-juniper

Sandsage-grassland

Figure 11.-- Map of the vegetation types of Cimarron County, Oklahoma, showing the location of study areas.(from Duck and Fletcher, 1943).

Table 4. Occurrence of Certain Habitat Elements on 10 Scaled Quail Winter Covey Homesteads, November, 1954 - March, 1955, Cimarron County, Oklahoma

Homestead Number	Rocky	Hilly	Flat	Building	Implements	Farmland	Shelterbelt	Short grass Pasture	Skunkbush	Forbs	Dense soapweed	Soapweed sage	Tree Cactus
1	X	X	-	-	-	-	-	-	X	-	X	-	-
2	-	-	X	X	X	X	-	X	-	X	-	-	-
3	X	X	-	X	-	-	-	-	X	-	X	-	-
4	-	-	X	X	X	X	-	-	-	X	-	-	-
5	-	-	X	X	X	-	-	-	X	-	-	X	-
6	-	-	X	X	X	X	X	X	-	X	-	X	-
7	-	-	X	X	X	X	-	-	-	-	-	X	-
8	-	-	X	X	X	-	-	-	-	-	-	X	-
9	-	-	X	-	X	-	-	-	-	-	-	X	-
10	X	X	X	X	-	X	-	-	X	-	X	-	X
Average Percent of Frequency	30	30	80	80	70	50	10	20	40	30	30	50	10

On nine of 10 scaled quail winter homesteads, skunkbush, tree cactus, or a cultural equivalent of overhead shrub cover, for example, farm implements, formed the main covey resting area during the non-feeding periods (Table 4). Soapweed-grassland, sandsage-grassland, sandsage-soapweed-grassland, to a lesser extent farmland, and occasionally open pasture served primarily as feeding and roosting grounds.

Habitat Niche-Use.--Scaled quail in Cimarron County were found in all of the major vegetation types. Among the "breaks" of the Cimarron River valley in the pinyon-juniper type, scaled quail commonly were observed on the rocky, brushy slopes. On the high plains, they were common about farmsteads. Frequently, the birds were seen about the rocky draws (Figure 12), gullies, and canyons which dissect the high plains. Skunkbush, wild grape, and currant were the common woody perennials growing in these areas. On the short-grass plains, the characteristic vegetation was low-growing short grass and scattered halfshrubs such as soapweed. This kind of vegetation was used infrequently by scaled quail (Tables 5, 6, and 7). On the rolling and duny sandy lands, scaled quail were distributed primarily about cultural situations and the adjacent sandsage-grassland (Figure 13).

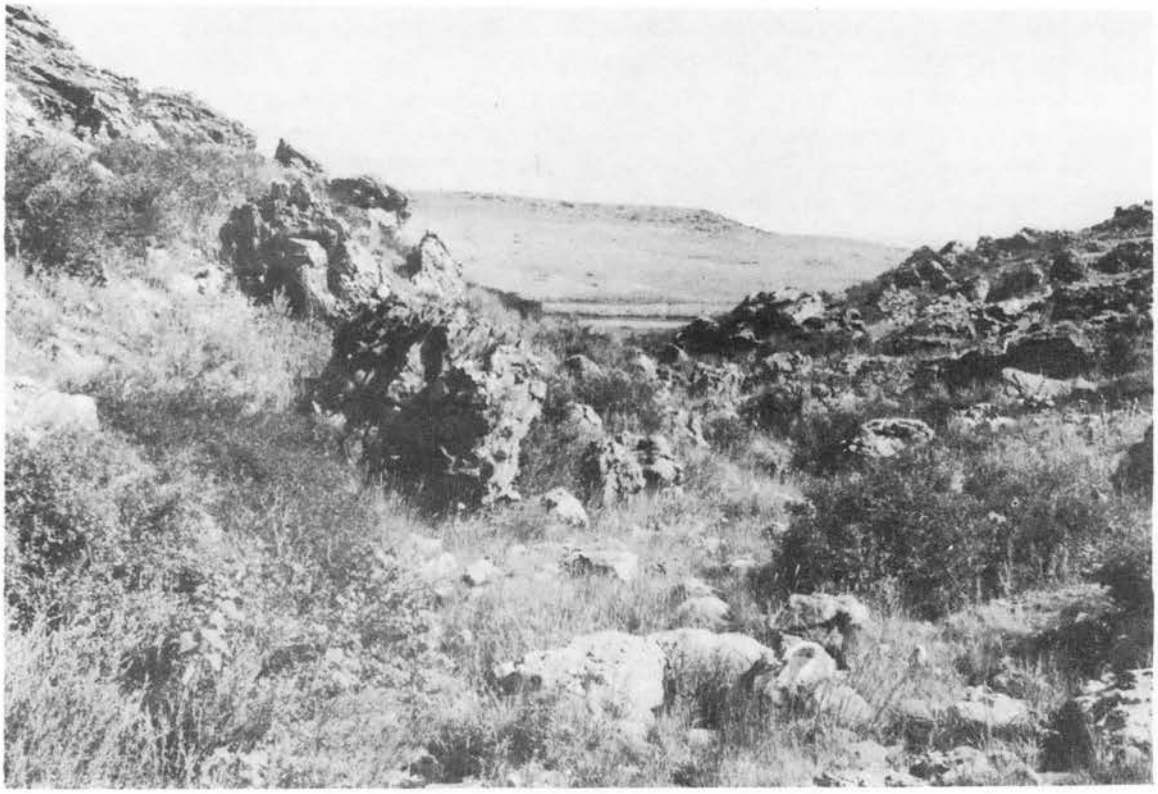


Figure 12.--Rocky draw dissecting the short-grass plains and overgrown with skunkbush and wild grape, Sterling Graham Ranch Study Area, six miles north of Boise City, Oklahoma, Cimarron County, August, 1957.

The shrub life-form was comprised of perennial woody growth varying in height from three to 20 feet. This life-form included 54 percent of the total "flush" observations made during this study (Table 5). Suitable cultural features around farmsteads accounted for an additional 29 percent of these observations. The remainder of the observations, 17 percent, involved areas of native grassland, stands of forbs, or cultivated fields.

A description and analysis of the important elements of scaled quail habitat is essential to an understanding of

habitat-use by the bird. Skunkbush, tree cactus, and dense soapweed were greatly favored by scaled quail in the pinyon-juniper type and included 71.8 percent of the total observations made in this type. Scaled quail were observed more frequently in dense soapweed-sandsage (13.7 percent) and dense soapweed (7.6 percent) niches than in sparse soapweed-sandsage (1.7 percent) and sparse soapweed (3.6 percent) niches (Table 5).

Figure 13.--Sandsage-soapweed-grassland interspersed with annual eriogonum, 14 miles west of Boise City, Oklahoma, Cimarron County, August, 1955.

The extensive use of cultural features (Tables 6 and 7) was accentuated by the low total acreage of this niche. Shelterbelts and forbs also received frequent use. Skunkbush on the short-grass study area served a major role as resting and escape cover (Table 8) despite its small total acreage (Table 6). Cultural features were of major importance as feeding and loitering sites and, to a lesser extent, as escape cover. Shelterbelts, dense soapweed-sandsage, and cropland, primarily grain stubble, provided essential escape cover (Tables 8 and 9).

Some types of situations were visited by scaled quail with a high frequency during all seasons of the year. On the short-grass study area, these types included cultural features and skunkbush (Figure 16). Forbs ranked higher in the winter and fall than at other seasons. Cropland and soapweed-skunkbush were used equally throughout the year but to a minor degree.

On the sandsage-grassland study area, a distinctive pattern of seasonal use of habitat niches was apparent (Figure 17). Cultural features were important elements of the habitat at all seasons of the year, although use in spring and summer was lighter than in fall and winter. Dense stands of soapweed-sandsage ranked second in importance. They were occupied to a greater extent during spring and summer. Shelterbelts and cropland were used chiefly during the winter in this vegetation type.

The relative use of various habitat niches for shelter when compared to their proportional availability provided a more accurate measure of the relative value and worth of the various habitat niches. As a means of accomplishing this end, observations were made on two study areas (Tables 6 and 7; Figures 14 and 15) that were assumed to be representative samples of the short-grass and sandsage-grassland vegetation types inhabited by scaled quail in Cimarron County.

Table 5. Habitat-Use by Scaled Quail Based on 2,048 Flush Observations in Three Vegetation Types in Cimarron County, Oklahoma, April, 1954 - January, 1957

Habitat Niche	Pinyon-Juniper		Short Grass		Sandsage		Total	
	No. of Observations	Percent of Total	No. of Observations	Percent of Total	No. of Observations	Percent of Total	No. of Observations	Percent of Total
Cultural Features								
Buildings	7	4.5	165	17.7	181	18.9	353	17.2
Implements	2	1.3	35	3.7	112	11.7	149	7.3
Post and Board piles	--	---	10	1.1	29	3.0	39	1.9
Junk piles	6	3.8	4	.4	27	2.8	37	1.8
Brush piles	--	---	3	.3	9	1.0	12	.6
Cattleguard	1	.6	3	.3	4	.4	8	.4
Culvert	--	---	--	---	2	.2	2	.1
Total Cultural	16	10.2	220	23.5	364	38.0	600	29.3
Vegetation								
Shrub Life-Form								
Skunkbush	31	19.9	270	28.9	10	1.1	311	15.2
Dense soapweed-sandsage*	--	---	--	---	281	29.4	281	13.7
Dense soapweed	25	16.0	90	9.6	41	4.3	156	7.6

*Used in the sense of Clements (1949)

Table 5--Continued

Habitat Niche	Pinyon-Juniper		Short Grass		Sandsage		Total	
	No. of Observations	Percent of Total	No. of Observations	Percent of Total	No. of Observations	Percent of Total	No. of Observations	Percent of Total
Shelterbelt	--	---	15	1.6	66	6.9	81	4.0
Sparse soapweed	7	4.5	33	3.5	33	3.4	73	3.6
Tree cactus	56	35.9	2	.2	2	.2	60	2.9
Soapweed-skunkbush	--	---	42	4.5	--	---	42	2.1
Sparse soapweed-sandsage	1	.6	--	---	34	3.5	35	1.7
Orchard	--	---	26	2.8	1	.1	27	1.3
Wild grape and currant	--	---	13	1.4	--	---	13	.6
Native juniper	11	7.1	--	---	--	---	11	.5
Sand plum	--	---	8	.9	2	.2	10	.5
Ornamental juniper	--	---	5	.5	--	---	5	.3
Sandsage	--	---	--	---	3	.3	3	.1
Total Shrub Life-Form	131	84.0	504	53.9	473	49.5	1,108	54.1
Others								
Forbs, clumps of	4	2.6	79	8.5	48	5.0	131	6.4
Cropland	1	.6	63	6.7	47	4.9	111	5.4
Open grassland	4	2.6	69	7.4	25	2.6	98	4.8
Total Others	9	5.8	211	22.6	120	12.5	340	16.6
Over-all Total	156	100.0	935	100.0	957	100.0	2,048	100.0

Table 6. Summary of Sight Observations of Scaled Quail as Related to the Availability of Associated Habitat Niches on the Sterling Graham Study Area, Short-Grass Vegetation Type, Six Miles North of Boise City, Oklahoma, June, 1954-September, 1956

Habitat Niche	Total Acres	Percent of Total Acres	Number of Observations	Percent of Total Observations	Observations per Acre
Forbs, Clumps of	1	.03	39	6.7	39.0
Cultural features	4	.11	132	22.8	33.0
Shelterbelt and ornamental juniper	1	.03	7	1.2	7.0
Skunkbush	68	1.85	226	39.1	3.3
Dense grass	1	.03	2	.4	2.0
Dense soapweed	526	14.26	61	10.6	.12
Soapweed-skunkbush	369	10.00	42	7.3	.11
Sparse soapweed	633	17.18	25	4.3	.04
Open grassland	1,281	34.73	30	5.2	.023
Cropland	803	21.78	14	2.4	.017
Total	640 /3,687 5.76 sq. mi.	100.00	578	100.0	--

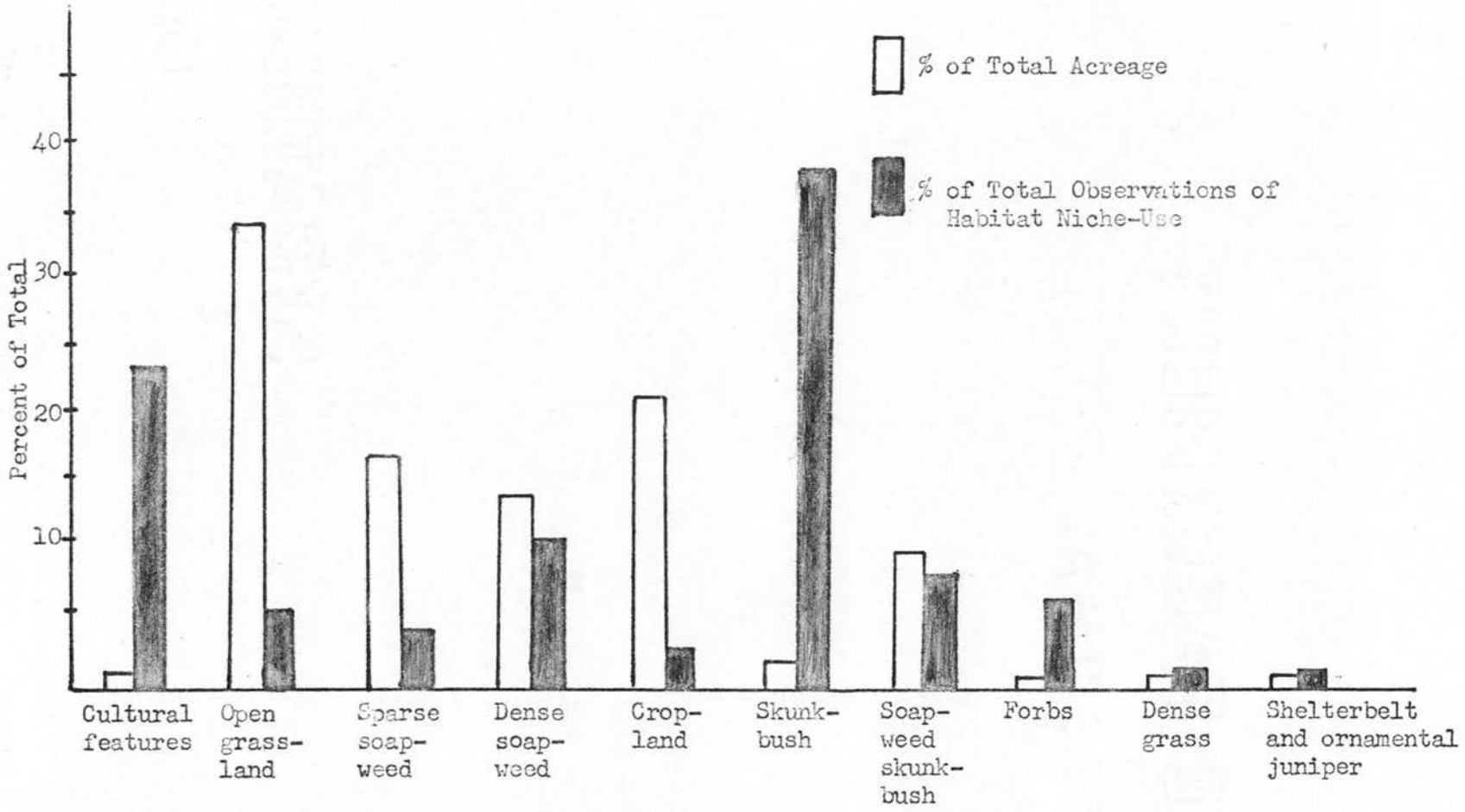


Figure 14.-- Relationship of habitat niche-use to availability by scaled quail on Sterling Graham short-grass study area, Cimarron County, Oklahoma, 1954-1957.

Table 7. Summary of Sight Observations of Scaled Quail as Related to the Availability of Associated Habitat Niches on the Holloway-Williams-Barnes Study Area, Sandsage-Grassland Vegetation Type, 10 Miles West of Boise City, Cimarron County, Oklahoma, August, 1954-January, 1957

Habitat Niche	Total Acres	Percent of Total Acres	Number of Observations	Percent of Total Observations	Observations per Acre
Shelterbelt	2	.01	55	7.3	27.5
Cultural features					
Buildings	17	.5	139		
Implements			99		
Junk pile			26		
Post and board piles			24		
Brush piles			4		
Cattleguard			3		
Culvert			2		
			297	39.2	17.5
Forbs	29	.9	31	4.1	1.1
Dense soapweed-grassland	59	1.9	18	2.4	.30
Open grassland	75	2.4	18	2.4	.24

Table 7--Continued

Habitat Niche	Total Acres	Percent of Total Acres	Number of Observations	Percent of Total Observations	Observations per Acre
Dense soapweed-sandsage-grassland	1,631	52.0	242	32.0	.15
Sparse soapweed grassland	252	8.0	22	2.9	.09
Cropland	615	19.7	42	5.6	.07
Sparse soapweed-sandsage-grassland	460	14.6	31	4.1	.07
Total	640 /3,140 4.9 sq. mi.	100.0	756	100.0	--

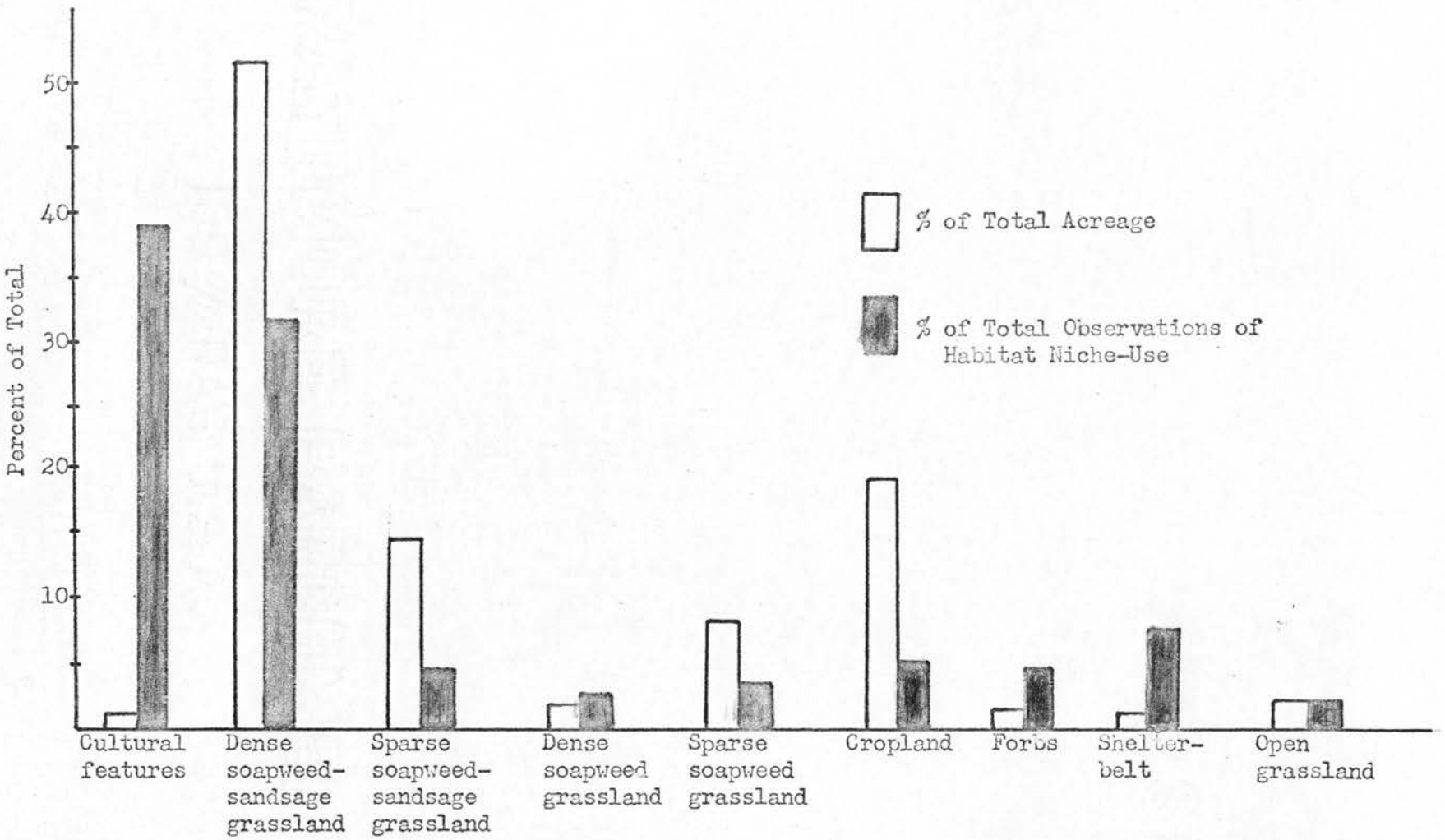


Figure 15.— Relationship of habitat niche-use by scaled quail to availability on Holloway-Williams-Barnes sandsage-grassland study area, Cimarron County, Oklahoma, 1954-1957.

Table 8. Summary of the Relative Use of Habitat Niches by Scaled Quail for Feeding, Resting, and Escape Activities on the Sterling Graham Study Area, Short-Grass Vegetation Type, Six Miles North of Boise City, Cimarron County, Oklahoma, June, 1954 - September, 1956

Habitat Niche	No. of Feeding Observations	Relative Rank of Importance of Habitat Niche for Feeding	No. of Resting Observations	Relative Rank of Importance of Habitat Niche for Resting	No. of Escape Observations	Relative Rank of Importance of Habitat Niche for Escape Cover
Cultural Features						
Buildings	100	1	15	2		
Implements	3	9	11	4	2	8
Barbed wire	--	--	1	9		
Vegetation						
Skunkbush	52	2	107	1	67	1
Dense soapweed	31	3	15	2	15	3
Sparse soapweed	13	7	4	6	8	5
Open grassland	22	4	5	5	3	7
Soapweed and skunkbush	21	5	14	3	7	6
Forbs	18	6	4	6	17	2

Table 8--Continued

Habitat Niche	No. of Feeding Observations	Relative Rank of Importance of Habitat Niche for Feeding	No. of Resting Observations	Relative Rank of Importance of Habitat Niche for Resting	No. of Escape Observations	Relative Rank of Importance of Habitat Niche for Escape Cover
Cropland	4	8	1	8	9	4
Shelterbelt and ornamental juniper	4	8	2	7	1	9
Dense grass	--	--	1	8	1	9
Total	268		180		130	

Table 9. Summary of the Relative Use of Habitat Niches by Scaled Quail for Feeding, Resting, and Escape Activities on the Holloway-Barnes-Williams Study Area, Sandsage-Grassland, 10 Miles West of Boise City, Cimarron County, Oklahoma, 1954-1956

Habitat Niche	No. of Feeding Observations	Relative Rank of Importance of Habitat Niche for Feeding	No. of Resting Observations	Relative Rank of Importance of Habitat Niche for Resting	No. of Escape Observations	Relative Rank of Importance of Habitat Niche for Escape Cover
Cultural Features						
Buildings	99	1	32	3	7	8
Machinery	38	3	48	2	13	3
Board piles	4	10	19	5	1	10
Junk piles	2	11	16	6	8	7
Culvert	1	12				
Brush pile			4	8		
Cattleguard	1	12	3	9		
Vegetation						
Shelterbelt	11	7	27	4	17	2
Dense soapweed	5	9	2	10	11	5
Sparse soapweed	7	8	3	9	12	4

Table 9--Continued

Habitat Niche	No. of Feeding Observations	Relative Rank of Importance of Habitat Niche for Feeding	No. of Resting Observations	Relative Rank of Importance of Habitat Niche for Resting	No. of Escape Observations	Relative Rank of Importance of Habitat Niche for Escape Cover
Open grassland	16	6	--	--	2	9
Dense soapweed and sandsage	81	2	50	1	111	1
Sparse soapweed and sandsage	15	6	7	7	9	6
Cropland	23	4	3	9	17	2
Forbs	21	5	2	10	8	7
Total	324	[illegible]	216		216	

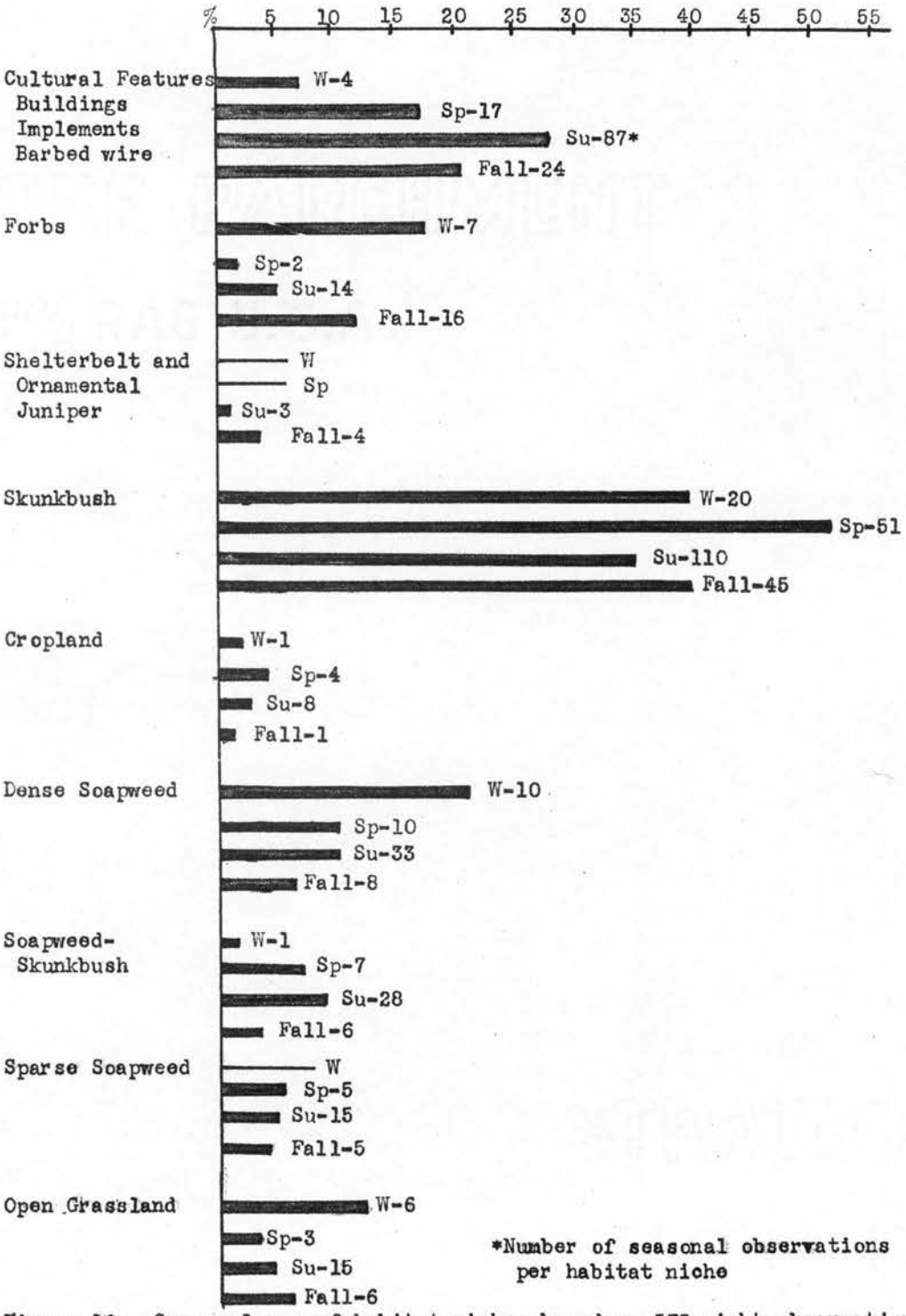


Figure 16. Seasonal use of habitat niches based on 578 sight observations of scaled quail on short grass-high plains study area, Cimarron County, Oklahoma, 1954-1957.

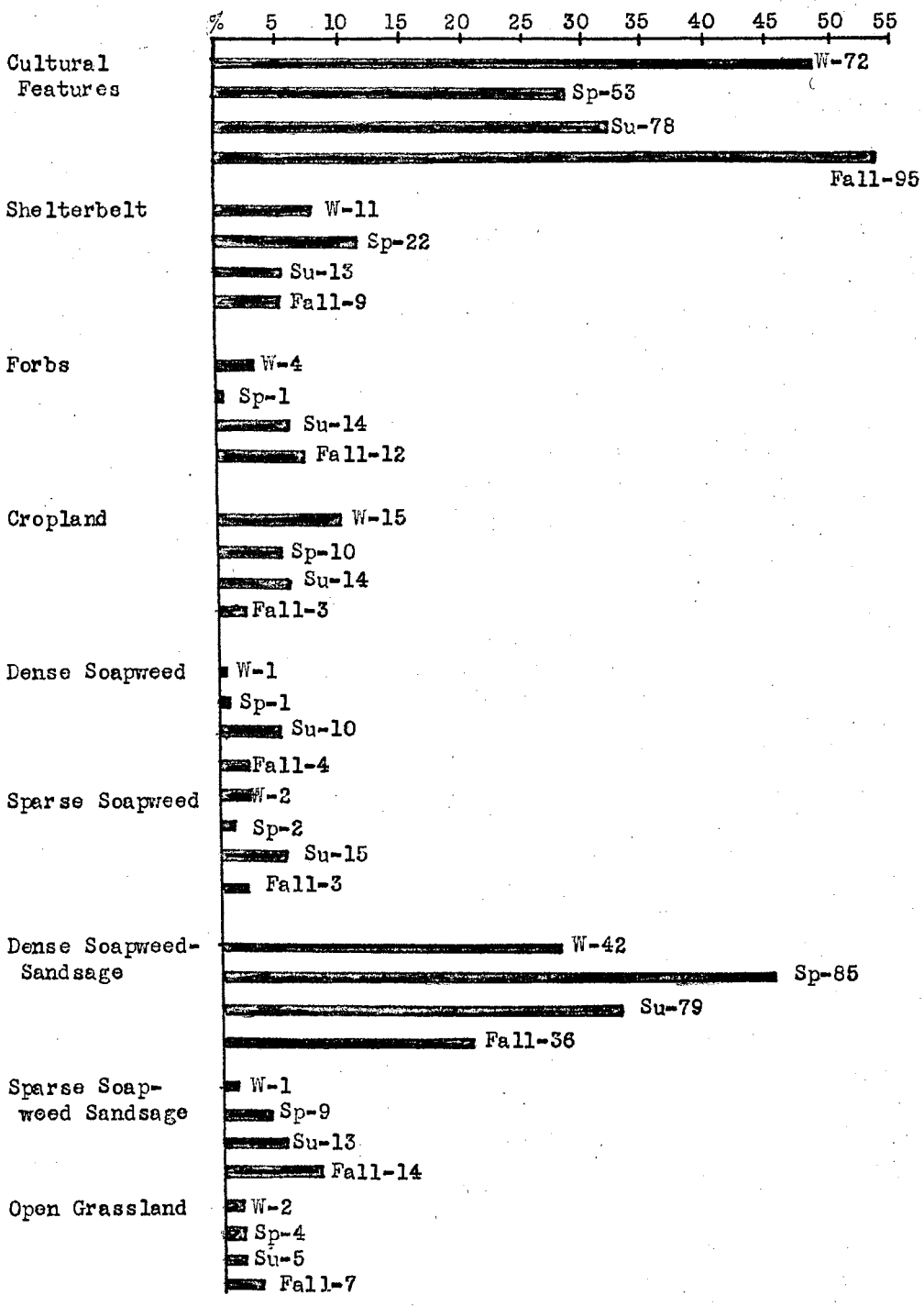


Figure 17. Seasonal use of habitat niches based on 756 sight observations of scaled quail on sandsage-grassland study area, Cimarron County, Oklahoma, 1954-1957.

Vegetation for Nesting Cover

Fifty scaled quail nests examined in Cimarron County during three successive breeding seasons, 1954, 1955, and 1956, were located in 16 distinct habitat situations (Table 10). Thirty-three of the nests, 66 percent, were restricted to four habitat situations in the following order of importance: (1) dead Russian thistle (Figure 18), (2) implements and junk, (3) mixed forbs (Figure 19), and (4) soapweed (Table 10). Russell (1932) described the locations of 24 scaled quail nests discovered in 1931 and 1932 in northeastern New Mexico. Sixteen of the nests that he reported upon were found in dead Russian thistle, mixed forbs, soapweed, Johnson grass (Sorghum halepense), and overhanging rocks in situations similar to those found in the present Oklahoma study. Sandsage and Johnson grass were nest sites used by scaled quail in the Texas Panhandle (Jackson, 1942). Long (1941) described a nest with eight scaled quail eggs in a windrow of Russian thistle in eastern Colorado. Bendire (1892) reported that scaled quail in southern Arizona and New Mexico nested under the shelter of a yucca or small bushes and occasionally in wheat and corn fields, alfalfa meadows, and potato patches. Many of the same situations were used for nest sites by scaled quail in Cimarron County (Table 10). The wide variety of sites utilized by scaled quail illustrates their wide range of adaptability in the selection of a nest location.

Table 10. Scaled Quail Nest Sites in Cimarron County, Oklahoma, 1954 (eight nests), 1955 (28 nests), and 1956 (14 nests)

Habitat Situation	Number of Nests	Percent of Total
Russian thistle (dead)	16	32
Implements and junk	8	16
Mixed forbs (e.g., sunflower, pigweed, western ragweed, few-flowered psoralea)	6	12
Soapweed	3	6
Sandsage	2	4
Johnson grass	2	4
Russian thistle (live)	2	4
Shock of feed, hay bale	2	4
Alfalfa	2	4
Orchard grass (*Dactylis glomerata*)	1	2
Wavy-leaved thistle[1]	1	2
Overhanging rock (under)	1	2
Wild gourd vine (*Cucurbita foetidissima*)	1	2
Prickly pear and broomweed[1]	1	2
Irrigated wheat	1	2
Rye straw and mixed forbs	1	2
Total	50	100

[1]Nests of scaled quail found in the pinyon-juniper vegetation type

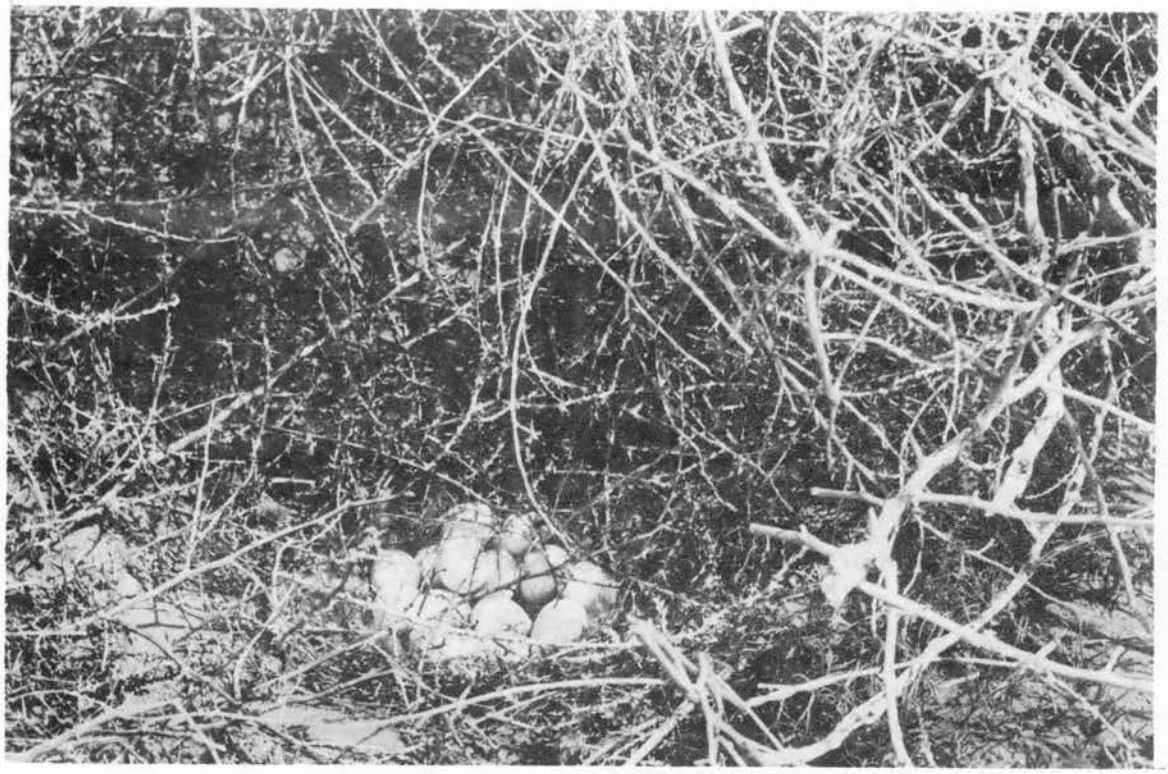


Figure 18.--Scaled quail nest, with 17 eggs, in dead Russian thistle, three miles west and two and one-half miles south of Boise City, June 17, 1956.

Food

The foods eaten by a game bird often suggest to the wildlife manager how he can manage the habitat of the bird to its advantage. Information on food-use sometimes may be related to the effects of conservative or destructive land-use practices upon the vegetation. In order to define more clearly the character of food-use by scaled quail, a detailed study was undertaken.

Figure 19.--Scaled quail nest site with 11 eggs that hatched successfully in mixed forbs in roadside ditch, 15 yards from Highway 3, Boise City, Oklahoma, August 30, 1955. The forbs pictured include sunflower, live Russian thistle, wavy-leaved thistle, and few-flowered psoralea.

Early Winter Food-Use.--Scaled quail made use of a broad variety of food materials (Table 11). Some items were rare in the diet while others were common. Among the latter were Russian thistle, pigweed, maize, sunflower, croton, few-flowered psoralea, insects, sand lily, gumweed, and kaffir.

Some foods were eaten in larger amounts in 1954-1955 than in 1955-1956.

Table 11. Food-Use Scaled Quail Based on the Analysis of 801 Crops, collected November 20, 1954 - January 1, 1955, and November 22, 1955 - January 2, 1956, Cimarron County, Oklahoma.

Name of Food Plant:	Pinyon - Juniper - Mesa - 384 Crops				Short grass - High plains - 118 Crops				Sandsage-grassland 299 Crops							
	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.	Total Freq.	% Total Freq.	Total Vol.	% Total Vol.
Amaranthus spp.	316	82.3	309.9	14.2	104	88.1	47.7	10.4	262	87.6	184.1	16.4	682	85.1	541.7	14.3
Salsola pestifer	241	62.8	358.2	16.4	73	72.2	24.7	5.4	204	68.2	131.7	11.7	518	64.7	514.6	13.6
Sorghum vulgare-Maize	27	7.0	21.8	1.0	97	82.2	150.4	32.8	193	64.5	314.6	27.9	317	39.6	486.8	12.9
Sorghum vulgare-Kaffir	15	3.9	6.8	.3	61	51.7	75.8	16.5	138	46.1	174.5	15.5	214	26.7	257.1	6.8
Helianthus spp.	165	43.0	178.7	8.2	55	46.6	34.0	7.4	67	22.4	31.6	2.8	287	35.8	244.3	6.5
Grindelia squarrosa	229	59.6	171.1	7.8	11	9.3	10.6	2.3	14	4.7	T*	T	254	31.7	181.7	4.8
Psoralea tenuiflora	242	63.0	175.9	8.0	19	16.1	3.0	.7	35	11.7	1.9	.2	296	37.0	180.8	4.8
Croton spp.	206	53.6	95.2	4.4	19	16.1	7.0	1.5	104	34.8	73.7	6.5	329	41.0	175.9	4.6
Mentzelia stricta	194	50.5	134.7	6.2	16	13.6	5.8	1.3	67	22.4	33.8	3.0	277	34.6	174.3	4.6
Solanum rostratum	71	18.5	59.4	2.7	26	22.0	11.5	2.5	93	31.1	32.9	2.9	190	23.7	103.8	2.8
Green herbage	200	52.1	75.6	3.5	50	42.2	16.5	3.6	62	20.7	9.1	.8	312	39.0	101.2	2.7
Panicum miliaceum	14	3.6	79.3	3.6	4	3.4	.7	.2	7	2.3	.9	.1	25	3.1	80.9	2.1
Ambrosia psilostachya	125	32.6	36.7	1.7	24	20.3	2.1	.5	56	18.7	16.3	1.4	205	25.6	55.1	1.5
Sporobolus cryptandrus	79	20.6	28.6	1.3	8	6.8	.2	T	41	13.7	3.3	.3	128	16.0	32.1	.9
Euphorbia marginata	56	14.6	26.9	1.2	1	.8	T	T	4	1.3	1.2	.1	61	7.6	28.1	.7
Cleome serrulata	49	12.8	20.3	.9	6	5.1	3.5	.8	--	--	--	--	55	6.9	23.8	.6
Portulacca spp.	46	12.0	20.8	.9	10	8.5	.1	T	13	4.3	.4	T	69	8.6	21.3	.6
Rhus trilobata	14	3.6	12.6	.6	3	2.5	.2	T	14	4.7	8.1	.7	31	3.9	20.9	.6
Celtis reticulata	32	8.3	17.7	.8	--	--	--	--	--	--	--	--	32	4.0	17.7	.5
Polygonum spp.	55	14.3	3.0	.1	13	11.0	T	T	53	17.7	14.5	1.3	121	15.1	17.5	.5
Cucurbita foetidissima	13	3.4	4.5	.2	1	.8	.3	.1	38	12.7	11.8	1.0	52	6.5	16.6	.4
Secale cereale-green	4	1.6	3.2	.2	12	10.2	9.9	2.2	8	2.7	3.4	.3	24	3.0	16.5	.4
Triticum aestivum-seed	10	2.6	2.8	.1	24	20.3	5.4	1.2	25	8.4	7.4	.7	59	7.4	15.6	.4
Dyssodia papposa	33	8.6	3.0	.1	12	10.2	.5	.1	35	11.7	11.6	1.0	80	10.0	15.1	.4
Ipomoea leptophylla	21	5.5	14.9	.7	--	--	--	--	1	.3	.2	T	22	2.7	15.1	.4
Paspalum stramineum	19	4.9	4.4	.2	11	9.3	1.1	.2	90	30.1	8.7	.8	120	15.0	14.2	.4
Secale cereale-seed	10	2.6	5.0	.2	17	14.4	1.6	.4	30	10.0	6.5	.6	57	7.1	13.1	.4
Gutierrezia sarothrae	58	15.1	12.8	.6	4	3.4	.2	T	6	2.0	T	T	68	8.5	13.0	.4
Cenchrus pauciflorus	28	7.3	10.5	.5	10	8.5	.3	.1	21	7.0	1.6	.1	59	7.4	12.4	.3
Argemone spp.	25	6.5	11.1	.5	4	3.4	.5	.1	4	1.3	.1	T	33	4.1	11.7	.3
Ipomoea spp.	58	15.1	11.1	.5	--	--	--	--	1	.3	T	T	59	7.4	11.1	.3
Hordeum vulgare	--	--	--	--	3	2.5	1.1	.2	13	4.3	8.9	.8	16	2.0	10.0	.3
Triticum aestivum-green	2	.5	T	T	15	12.7	9.1	2.0	7	2.3	.6	.1	24	3.0	9.7	.3
Asclepias spp.	46	12.0	9.5	.4	1	.8	T	T	--	--	--	--	47	5.9	9.5	.3
Sorghum halepense	8	2.1	.6	T	18	15.3	8.5	1.9	8	2.7	.3	T	34	4.2	9.4	.3
Polanisia trachysperma	17	4.4	8.0	.4	2	1.7	T	T	8	2.7	1.1	.1	27	3.4	9.1	.2
Zea mays	5	1.3	.5	T	10	8.5	4.7	1.0	7	2.3	2.4	.2	22	2.7	7.6	.2
Convolvulus spp.	26	6.8	6.4	.3	--	--	--	--	--	--	--	--	26	3.3	6.4	.2
Evolvulus pilosus	87	10.9	3.9	.2	3	2.5	T	T	34	11.4	1.6	.1	124	15.5	5.5	.2

*T represents trace of food present in quantities less than 0.1 cubic centimeter

Table 11 (Continued)

Name of Food Plant:	Pinyon - Juniper - Mesa - 384 Crops				Short grass - High plains - 118 Crops				Sandsage-grassland 299 Crops				Total Freq.	% Total Freq.	Total Vol.	% Total Vol.
	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.				
Euphorbia fendleri	48	12.5	1.8	.1	9	7.6	.6	.1	22	7.4	3.1	.3	79	9.9	5.5	.2
Cirsium spp.	30	7.8	3.2	.2	6	5.1	.3	.1	8	2.7	1.8	.1	44	5.5	5.3	.1
Heliotropium convolvulaceum	--	--	--	--	6	5.1	1.2	.3	4	1.3	4.0	.4	10	1.2	5.2	.1
Sorthum vulgare-Broom corn	4	1.0	T	T	9	7.6	.2	T	30	10.0	4.4	.4	43	5.4	4.6	.1
Kallstroemia intermedia	23	6.0	3.5	.2	1	.8	.4	.1	10	3.3	.7	.1	34	4.2	4.6	.1
Sporobolus heterolepis	4	1.0	4.5	.2	--	--	--	--	--	--	--	--	4	.5	4.5	.1
Eragrostis spp.	8	2.1	4.3	.2	3	2.5	T	T	5	1.7	T	T	16	2.0	4.3	.1
Andropogon saccharoides	8	2.1	4.3	.2	--	--	--	--	--	--	--	--	8	1.0	4.3	.1
Kochia scoparia	19	4.9	1.0	.1	9	7.6	2.4	.5	13	4.3	.8	.1	41	5.1	4.2	.1
Setaria spp.	15	3.9	2.9	.1	--	--	--	--	13	4.3	.7	.1	28	3.5	3.6	.1
Tridens elongatus	23	6.0	3.3	.2	--	--	--	--	--	--	--	--	23	2.9	3.3	.1
Desmanthus jamesii	25	6.5	2.0	.1	4	3.4	.9	.2	8	2.7	.3	T	37	4.6	3.2	.1
Opuntia imbricata	48	12.5	2.8	.1	--	--	--	--	--	--	--	--	48	6.0	2.8	.1
Verbesina encelioides	13	3.4	2.7	.1	--	--	--	--	6	2.0	T	T	19	2.4	2.7	.1
Panicum spp.	38	9.9	.8	T	11	9.3	.9	.2	30	10.0	.7	.1	79	9.9	2.4	.1
Verbena bracteosa	20	5.2	1.8	.1	6	5.1	.1	T	12	4.0	.5	T	38	4.7	2.4	.1
Oenothera spp.	22	5.7	2.2	.1	1	.8	T	T	1	.3	T	T	24	3.0	2.2	.1
Breweria pickeringii	23	6.0	1.9	.1	--	--	--	--	1	.3	T	T	24	3.0	1.9	.1
Monarda spp.	15	3.9	1.5	.1	1	.8	.2	T	--	--	--	--	16	2.0	1.7	.1
Euphorbia dentata	24	6.3	1.5	.1	1	.8	T	T	1	.3	T	T	26	3.3	1.5	T
Rumex spp.	--	--	--	--	--	--	--	--	5	1.7	1.5	.1	5	.6	1.5	T
Tragia nepetaefolia	23	6.0	1.3	.1	3	2.5	T	T	2	.7	T	T	28	3.3	1.3	T
Melilotus spp.	12	3.1	.9	T	1	.8	T	T	18	6.0	.3	T	31	3.9	1.2	T
Physalis spp.	6	1.5	1.2	.1	2	1.7	T	T	11	3.7	T	T	19	2.4	1.2	T
Unidentified seed	--	--	--	--	--	--	--	--	4	1.3	1.2	.1	4	.5	1.2	T
Eriogonum annuum	35	9.1	1.0	.1	5	4.2	.1	T	6	2.0	T	T	46	5.7	1.1	T
Medicago sativa	5	1.3	1.1	.1	--	--	--	--	--	--	--	--	5	.6	1.1	T
Juniperus spp.	13	3.4	1.0	.1	--	--	--	--	--	--	--	--	13	1.6	1.0	T
Opuntia spp.	12	3.1	1.0	.1	--	--	--	--	--	--	--	--	12	1.5	1.0	T
Kuhnia eupatoriodes	5	1.3	1.0	.1	--	--	--	--	--	--	--	--	5	.6	1.0	T
Commelina spp.	8	2.1	.5	T	2	1.7	T	T	11	3.7	.4	T	21	2.6	.9	T
Liatris punctata	6	1.6	.9	T	--	--	--	--	--	--	--	--	6	.7	.9	T
Franseria tenuifolia	--	--	--	--	--	--	--	--	5	1.7	.9	.1	5	.6	.9	T
Solanum carolinense	7	1.8	.2	T	1	.8	T	T	24	8.0	.5	T	32	4.0	.7	T
Lithospermum linearifolium	42	10.9	.6	T	2	1.7	T	T	13	4.3	T	T	57	7.1	.6	T
Mamillaria vivipara	7	1.8	.6	T	--	--	--	--	--	--	--	--	7	.9	.6	T
Rabbit scat pellet	--	--	--	--	--	--	--	--	1	.3	.6	.1	1	.1	.6	T
Hoffmanseggia spp.	10	2.6	.3	T	1	.8	.2	T	2	.7	T	T	13	1.6	.5	T
Desmanthus illinoensis	10	2.6	.5	T	--	--	--	--	--	--	--	--	10	1.2	.5	T
Lotatium sp.	8	2.1	.5	T	--	--	--	--	--	--	--	--	8	1.0	.5	T

Table 11 (Continued)

Name of Food Plant:	Pinyon - Juniper - Mesa - 384 Crops				Short grass - High plains - 118 Crops				Sandsage-grassland 239 Crops				Total	% Total	Total	% Total
	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.	Freq.	Freq.	Vol.	Vol.
Tribulus terrestris	--	--	--	--	--	--	--	--	7	2.3	.5	--	7	.9	.5	T
Mimosa borealis	2	.5	.2	T	2	1.7	.3	.1	--	--	--	--	4	.5	.5	T
Bouteloua spp.	11	2.9	.2	T	--	--	--	--	7	2.3	.2	T	18	2.2	.4	T
Sorghum sudanese	3	.8	.4	T	--	--	--	--	--	--	--	--	3	.4	.4	T
Aster tanacetifolius	6	1.6	.3	T	--	--	--	--	1	.3	T	T	7	.9	.3	T
Eriogonum sp.	3	.8	T	T	3	2.5	.3	.1	--	--	--	--	6	.7	.3	T
Ribes odoratum	1	.3	T	T	--	--	--	--	2	.7	.3	T	3	.4	.3	T
Woody material	1	.3	.3	T	--	--	--	--	--	--	--	--	1	.1	.3	T
Cuscuta spp.	10	2.6	.2	T	4	3.4	T	T	3	1.0	T	T	17	2.1	.2	T
Iva xanthifolia	5	1.3	.1	T	--	--	--	--	3	1.0	.1	T	8	1.0	.2	T
Psoralea hypogea	6	1.6	.1	T	--	--	--	--	2	.7	.1	T	8	1.0	.2	T
Petalostemum spp.	6	1.6	.1	T	--	--	--	--	4	1.3	.1	T	10	1.2	.2	T
Avena sativa	--	--	--	--	--	--	--	--	3	1.0	.2	T	3	.4	.2	T
Poa sp.	--	--	--	--	--	--	--	--	1	.3	.2	T	1	.1	.2	T
Strophostyles pauciflora	--	--	--	--	--	--	--	--	1	.3	.2	T	1	.1	.2	T
Corispermum sp.	2	.5	T	T	5	4.2	.1	T	12	4.0	T	T	19	2.4	.1	T
Echinocereus spp.	8	2.1	.1	T	--	--	--	--	--	--	--	--	8	1.0	.1	T
Allionia incarnata	1	.3	T	T	--	--	--	--	3	1.0	.1	T	4	.5	.1	T
Euphorbia sp.	3	.8	.1	T	--	--	--	--	--	--	--	--	3	.4	.1	T
Allium spp.	2	.5	.1	T	--	--	--	--	--	--	--	--	2	.2	.1	T
Datura stramonium	--	--	--	--	--	--	--	--	1	.3	.1	T	1	.1	.1	T
Astragalus nutallianus	1	.3	.1	T	--	--	--	--	--	--	--	--	1	.1	.1	T
Malus sp.	--	--	--	--	1	.8	.1	T	--	--	--	--	1	.1	.1	T
Mollugo verticillata	11	2.9	T	T	--	--	--	--	--	--	--	--	11	1.4	T	T
Astragalus reverchonii	9	2.3	T	T	--	--	--	--	1	.3	--	--	10	1.2	T	T
Atriplex canescens	5	1.3	T	T	--	--	--	--	4	.3	T	T	9	1.1	T	T
Malvastrum coccineum	7	1.8	T	T	--	--	--	--	--	--	--	--	7	.9	T	T
Salvia lanceolata	2	.5	T	T	3	2.5	T	T	--	--	--	--	5	.6	T	T
Chamaesaracha sp.	4	1.0	T	T	1	.8	T	T	--	--	--	--	5	.6	T	T
Linum spp.	2	.5	T	T	--	--	--	--	3	1.0	T	T	5	.6	T	T
Festucca spp.	4	1.0	T	T	--	--	--	--	--	--	--	--	4	.5	T	T
Amorpha sp.	3	.8	T	T	--	--	--	--	1	.3	T	T	4	.5	T	T
Lappula sp.	3	.8	T	T	--	--	--	--	--	--	--	--	3	.4	T	T
Chrysopsis berlandieri	2	.5	T	T	--	--	--	--	--	--	--	--	2	.2	T	T
Lesquerella ovalifolia	2	.5	T	T	--	--	--	--	--	--	--	--	2	.2	T	T
Sorghastrum nutans	1	.3	T	T	--	--	--	--	1	.3	T	T	2	.2	T	T
Heterotheca subaxillaris	--	--	--	--	1	.8	T	T	1	.3	T	T	2	.2	T	T
Carex spp.	1	.3	T	T	--	--	--	--	1	.3	T	T	2	.2	T	T
Chara oogonia	--	--	--	--	1	.8	T	T	--	--	--	--	1	.1	T	T

Table 11 (Continued)

Name of Food	Pinyon - Juniper - Mesa - 384 Crops				Short grass - High plains - 118 Crops				Sandsage-grassland 299 Crops				Total Freq.	% Total Freq.	Total Vol.	% Total Vol.
	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.	Freq.	% Freq.	Vol.	% Vol.				
Plant:																
Quercus sp.	1	.3	T	T	--	--	--	--	--	--	--	--	1	.1	T	T
Yucca glauca	--	--	--	--	1	.8	T	T	--	--	--	--	1	.1	T	T
Lupinus sp.	1	.3	T	T	--	--	--	--	--	--	--	--	1	.1	T	T
Marsilea sp.	--	--	--	--	1	.8	T	T	--	--	--	--	1	.1	T	T
Buchloe dactyloides	1	.3	T	T	--	--	--	--	--	--	--	--	1	.1	T	T
Euphorbia hexagona	--	--	--	--	--	--	--	--	1	.3	T	T	1	.1	T	T
Cryptantha sp.	1	.3	T	T	--	--	--	--	--	--	--	--	1	.1	T	T
Subtotal			2006.3	91.9			445.3	97.1			1123.3	99.4			3574.9	94.6
Animal:																
Orthoptera	91	23.7	24.8	1.1	6	5.1	1.5	.3	8	2.7	2.1	.2	105	13.1	28.4	.8
Hemiptera																
Miridae	70	18.2	124.4	5.7	7	5.6	5.5	1.2	11	3.7	3.5	.3	88	11.0	133.4	3.5
Pentatomidae	22	5.7	10.6	.5	3	2.5	1.9	.4	--	--	--	--	25	3.1	12.5	.3
Corizidae	59	15.4	9.4	.4	4	3.4	.2	T	1	.3	T	T	64	8.0	9.6	.3
Lygaeidae	16	4.2	2.3	.1	3	2.5	1.7	.4	--	--	--	--	19	2.4	4.0	.1
Cydnidae	18	4.7	.6	T	5	4.2	.3	.1	2	.7	.1	T	25	3.1	1.0	T
Miscellaneous	3	.8	.2	T	--	--	--	--	--	--	--	--	3	.4	.2	T
Anthocoridae	--	--	--	--	--	--	--	--	1	.3	T	T	1	.1	T	T
Nabidae	1	.3	T	T	--	--	--	--	--	--	--	--	1	.1	T	T
Tingidae	--	--	--	--	--	--	--	--	1	.3	T	T	1	.1	T	T
Homoptera																
Cicadellidae	22	5.7	1.9	.1	1	.8	T	T	4	1.3	.2	T	27	3.4	2.1	.1
Coccidae	3	.8	.2	T	--	--	--	--	--	--	--	--	3	.4	.2	T
Membracidae	1	.3	.1	T	--	--	--	--	--	--	--	--	1	.1	.1	T
Coleoptera	57	14.8	4.6	.2	11	9.3	.5	.1	32	10.7	1.5	.1	100	12.5	6.6	.2
Hymenoptera	15	3.9	.3	T	2	1.7	T	T	2	.7	T	T	19	2.4	.3	T
Diptera	8	2.1	.1	T	--	--	--	--	11	3.7	.2	T	19	2.4	.3	T
Insect fragments	17	4.4	.1	T	6	5.1	1.6	.4	7	2.3	T	T	30	3.7	1.7	.1
Snail	12	3.1	.4	T	--	--	--	--	1	.3	T	T	13	1.6	.4	T
Insect egg	8	2.1	.3	T	--	--	--	--	--	--	--	--	8	1.0	.3	T
Spider	--	--	--	--	--	--	--	--	2	.7	.1	T	2	.2	.1	T
Tick	--	--	--	--	--	--	--	--	3	1.0	T	T	3	.4	T	T
Subtotal			180.3	8.1			13.2	2.9			7.7	.6			201.2	5.4
Grand Total			2186.6	100.0			458.5	100.0			1131.0	100.0			3776.1	100.0

These included snow-on-the-mountain, sand paspalum, sandbur, purslane, skunkbush, bush morning-glory, Fendler spurge, milkweed, and leaf bugs.

Some plant seeds were not eaten in proportion to their availability. Jimson weed was a common plant on sandy soils. It sheds a supply of seed beneath the plant during the early winter, yet jimson seed was found in only two of the crops examined. Juniper berries also were common under the trees during all seasons of the year in the pinyon-juniper type of vegetation. Despite this high availability, relatively few berries were eaten by scaled quail.

Variety of Foods Eaten.--The variety of plant food items per crop varied decidedly in each of the three vegetation types (Table 12). The two extreme values of 5.9 in the sandsage-grassland and 9.9 in the pinyon-juniper type for the average number of food plants per crop (Table 12) were compared by using a standard t test (Snedecor, 1946). A significant difference was found at the 0.05 level of probability. Two possible explanations of these differences may have been the greater variety and lesser density of the vegetation in the pinyon-juniper type or the lesser variety and greater density of the different food plants in the sandsage-grassland type.

Table 12. Average and Maximum Number of Food Items per Crop in 801 Scaled Quail Crops, Cimarron County, Oklahoma, November-January, 1954-1955 and 1955-1956

Vegetation Type	1954 - 1955 Av. No. of Plant Foods per Crop	S.D.	Max. No. of Foods per Crop	1955 - 1956 Av. No. of Plant Foods per Crop	S.D.	Max. No. of Foods per Crop
Pinyon-juniper	9.9	±4.5	24	8.6	±3.65	22
Short grass	7.1	±3.65	19	7.7	±3.8	20
Sand-sage	8.3	±3.6	18	5.9	±2.35	13

This type of measure was employed by Hanson (1953) who found it useful as an index to the variety of foods eaten.

The maximum number of foods per crop was 24 in the pinyon-juniper type which illustrates the considerable variety of foods consumed by scaled quail in the type. Even under the conditions of severe drought, as occurred during 1954 and 1955, a number of plants produced seed which were fed upon by quail. The diversity of food use by scaled quail suggests a wide range of food adaptability of this bird.

If food were a serious limiting factor, a quail habitat productive of a large variety of foods might be expected to support a higher population of birds more consistently than a habitat possessing a more limited variety of plant foods.

In an environment having a large variety of food plants in the event of adverse weather and land-use practices, there would be a greater possibility of one or more plants surmounting the unfavorable conditions and maturing seeds.

Classes of Food Eaten and Land-Use.--Of the 20 leading foods eaten by scaled quail during the period of this study, 11 were seeds of annual and perennial forbs, two were agricultural grains, two were insects, two were grass seeds, one was a legume seed, one was a shrub fruit, and one was leafy material.

The primary sources of scaled quail food were the seeds of annual and perennial forbs. Many of these, including pigweed, Russian thistle, sunflower, and western ragweed, are considered to be agricultural pests. The only previous food-use report of scaled quail in Cimarron County was by Bird and Bird (1931). They found Russian thistle and sunflower seed to compose 92.8 percent of the volume of four crops collected in December.

Many of the common quail food plants were not eaten extensively by livestock. Some of the plants in this category included doveweed, sand lily, tragia, buffalo bur, snow-on-the-mountain, milkweed, prickly-poppy, bush morning-glory, broomweed, bee flower, wavy-leaved thistle, purslane, and annual eriogonum. Although escape and nesting cover may be harmed by the trampling activities of livestock, the quail food supply did not seem to be limited seriously by

heavy grazing pressure. Only a few quail foods were provided by plants classified by Engleman and Nelson (1948) as increasers in their response to overstocking of livestock. These included silver evolvulus, few-flowered psoralea, umbrella-wort, golden aster, lead plant, prairie clover, chamaesaracha, and blazing star.

In 1955, 199,000 acres of land in Cimarron County were planted to sorghum (Bureau of Census, 1956). Maize and kaffir had a high availability and were consumed in large amounts and frequency by scaled quail. Also, in 1955, 188,000 acres of land were seeded to wheat, and 183,000 acres of this total, 97.3 percent, were abandoned and not harvested primarily because of the drought. Many of these abandoned wheat fields contained thin stands of wheat with mature heads of grain which were left as a cover crop against wind damage. Despite this high acreage of abandoned wheat land containing waste grain, wheat ranked far down the list as a food (Table 11). Wheat may have been a more important food during the summer and early fall. Broom corn acreage was small, totaling only 8,000 acres in 1955, and the seed also was eaten in relatively minor amounts by the birds. Oats and barley were not planted regularly in the usual crop rotation practiced in Cimarron County. Neither of these two grains appeared to be important quail foods.

Sand dropseed and sand paspalum composed 0.9 and 0.4 percent of the total food volume. Sandbur, Johnson grass,

and panic grass seeds were eaten in lesser quantity and frequency, but they still may be considered to be more important than some other grasses occurring only in minor amounts and frequencies as food. These grasses included silver beardgrass, grama, Indian, love, foxtail, prairie dropseed, buffalo, rough tridens, and bluegrass.

Only one legume, few-flowered psoralea, was an important scaled quail food (Table 11). The seed of other legumes, including lead plant, milkvetch, bundleflower, rushpea, sweet clover, lupine, prairie clover, wild bean, and alfalfa, were consumed only in limited amounts.

With the exception of skunkbush and hackberry, shrubs and trees provided only minor amounts of food during the period of this study. Representatives of these plants furnishing quail food included juniper, tree cactus, wild currant, soapweed, catclaw, and four-winged saltbush. The fruit and seed of wild grape, rabbit brush, sandsage, and brickellbush, all common woody plants, did not occur in the sample of crops examined (Table 11).

Insects were eaten in greater quantities by scaled quail inhabiting the pinyon-juniper vegetation type (Table 11). Variation in insect consumption in the early winter may be related to differences in insect availability or to other food availability. The birds may not have found as large a population of insects available for food in the sandsage-grassland and short-grass vegetation types as they

found in the pinyon-juniper type. These vegetation types contained a greater proportion of cultivated lands than did the pinyon-juniper type. Dambach (1948), who sampled insect populations in sod fence-rows and cultivated fields in Ohio, found a notably smaller insect population in the cultivated fields.

Several forms of insects ranked high as scaled quail foods (Table 11). A leaf bug of the genus Lygus seemed to be particularly important. Several crops were filled completely with this insect. The frequent use of this bug in large quantities for food may have been indicative of a plentiful availability of these insects. Grasshoppers, beetles, stinkbugs, leafhoppers, box elder, and milkweed bugs were other more important insect foods of quail.

A marked variation was apparent in the amount of insect material consumed during the two seasons of sampling. For example, insect material composed 8 percent of the total food intake in 1954-1955, as compared with only 0.8 percent in 1955-1956. Similarly, the number of crops containing insect material decreased from 47.8 percent in 1954-1955 to 32.7 percent in 1955-1956. Kelso (1937) examined a winter sample of 156 scaled quail crops from Arizona, New Mexico, Mexico, and Texas and found that insect material composed 5.9 percent of the total food eaten. Wallmo (1956a), who found only a trace of insect material in winter scaled quail

crops from west Texas, was the only other worker who listed comparable information on scaled quail insect consumption.

Annual Scaled Quail Food-Use and Feeding Habits.--Only a very small sample of scaled quail crops and gizzards from birds obtained outside of the hunting season was available. Most of the food-use information presented in Table 13 was collected from accidental deaths. Due to the scantiness of the sample, the relative significance of the analysis is limited.

No foods were found in the annual sample (Table 13) which were not reported in the hunting season sample (Table 11). Pigweed seed and green material were consumed during all four seasons. Few-flowered psoralea, sand dropseed, Fendler spurge, sand paspalum, sunflower, maize, and kaffir were eaten during three of the four seasons of the year.

Customarily, scaled quail usually fed in the early morning from daybreak until about 10 a.m. and in the evening from about 4 p.m. until dark. The exact times of feeding periods varied considerably with the season of the year and the air temperature. Scaled quail were seen actively foraging for food during a rain which wetted their plumage and left them bedraggled looking. During snow storms, scaled quail tended to refrain from feeding. Instead, they remained in dense cover roosting in loose groups. If the snowfall ceased during the daylight hours, the quail would start feeding.

Table 13. Frequency of Use of Non-Hunting Season Scaled Quail Foods Based on the Analysis of 27 Scaled Quail Crops and 16 Gizzards, 1954-1956, Cimarron County, Oklahoma

Name of Food	Season of Use			
	Spring[1] (9)[2]	Summer (12)	Fall (17)	Winter (5)
Plant:				
Salsola pestifer	6[3]			3
Amaranthus spp.	8	10	10	4
Commelina sp.		3		
Green material	4	1	2	2
Panicum spp.		5	1	1
Psoralea tenuiflora		1	5	2
Sorghum halepense				1
Cuscuta sp.	1			
Grindelia squarrosa				1
Sporobolus cryptandrus	1		1	1
Euphorbia fendleri		1	2	1
Paspalum stramineum		1	3	1
Ambrosia psilostachya		1	3	1
Atriplex canescens	4			
Verbesina enceliodes	3			
Kallstroemia intermedia	2			
Gutierrezia sarothrae	2			
Helianthus spp.	1	1	1	
Datura stramineum	1			
Polonisia trachysperma	1			

Table 13--Continued

Name of Food	Season of Use			
	Spring[1] (9)[2]	Summer (12)	Fall (17)	Winter (5)
Portulacca sp.	1	2		
Polygonum spp.	1	1		
Verbena bracteosa	1		1	
Tridens sp.	1			
Bouteloua spp.	1			
Croton spp.		5	10	
Lithospermum linearifolium		1		
Evolvulus pilosus		1	3	
Convolvulus spp.		1		
Psoralea hypogea		1		
Oenothera sp.		1	1	
Heliotropium convolvulaceum			1	
Petalostemum sp.		1		
Mentzelia stricta		2		
Chamaesaracha sp.			1	
Euphorbia marginata			1	
Physalis sp.		1		
Sorghum vulgare	1	1		1
Animal:				
Coleoptera	2	8	3	
Insect fragments	1	1	1	
Ants		1		
Grasshopper		4	2	

Table 13--Continued

Name of Food	Season of Use			
	Spring[1] (9)[2]	Summer (12)	Fall (17)	Winter (5)
Hemiptera	1		1	
Pentatomidae		2		1
Cicadellidae		2		
Corizidae		1		
Miridae		4		
Lygaeidae		1		
Hymenoptera			1	

[1]In this table, spring is taken as the period from March-May; summer, June-August; fall, September-October; and winter, January-February.

[2]Number of season samples.

[3]Frequency of food consumption.

Scaled quail were observed perched in trees well above the ground on six occasions. This behavior suggests that, during periods of deep snow when ground foods are covered, scaled quail could find and use such foods as hackberry, skunkbush, and juniper fruits as well as acorns. This might be important when the more usual foods are covered with snow.

Seeds of spiny nature, although unpleasant to the human touch, were not avoided by scaled quail as a food source. Two such seeds, sandbur and goathead, were consumed with some frequency (Table 11).

Despite drought conditions, a large variety of widely distributed foods were eaten by scaled quail throughout the year. This behavior suggests that the food supply was usually ample.

Water

The need of water by desert quail has long been a matter of concern to ecologists, naturalists, and sportsmen. Willard (in Bent, 1932) noted scaled quail in Cochise County, Arizona, inhabiting an area seven or eight miles from the nearest water. Russell (1932) reported that in New Mexico it was not unusual to find scaled quail 10 to 15 miles from water. Wallmo (1956a) observed scaled quail coveys during the winter at three and seven miles from water in Big Bend National Park in southwest Texas.

The distribution of water sources available to scaled quail was represented by a sample that included study areas examined during this investigation (Table 14). Thirty-five water sources were present on 15,040 acres, or one water source per 430 acres.

Scaled quail were found situated more closely to water during the winter than at other seasons (Table 15). The maximum distance that the birds were seen from water was one and one-quarter miles.

Distribution in relation to water also varied from one vegetation type to another. The average distance to water at which quail were observed was considerably less in the short-grass type than in the other two vegetation types sampled (Table 15). Much of the short-grass type was cultivated farmland. Cover preferred for shelter by quail was provided by the cultural features usually located in association with farmsteads. Here there usually was a water source readily available for quail. The over-all mean distance to water was greater in the sandsage-grassland than in the other two types. This behavior was in agreement with the comparative lack of watering areas in this type (Table 14).

The mere listing of an average distance to water per observation masked some relationships. For example, the maximum distance that a quail could be observed from a water source often was limited by the proximity of the various water sources on an area.

Table 14. Number of and Maximum Distance Between Watering Areas on Scaled Quail Study Tracts in Cimarron County, Oklahoma, 1954 - 1956

Study Area	Vegetation Type	Area Mapped	Number of Watering Areas	Acres per Watering Area	Maximum Distance between Watering Areas
J. R. Eiland	Pinyon-juniper	3,840 acres	9	426	1,760 yards
Sterling Graham	Short grass	4,480 acres	14	320	1,760 yards
J. G. Mayhan	Sandsage-grassland	2,880 acres	5	576	2,200 yards
E. Williams H. Barnes L. Holloway	Sandsage-grassland	3,840 acres	7	548	1,760 yards
	Total	15,040 acres	35	430 acres average	

Table 15. Mean Distance to Water Based on 1,046 Scaled Quail Observations by Season and Vegetation Type, Cimarron County, Oklahoma, 1954-1956

Season	Pinyon-Juniper		Sandsage-Grassland		Short Grass	
	Number of Observations	Average Distance to Water	Number of Observations	Average Distance to Water	Number of Observations	Average Distance to Water
Winter						
December						
January						
February	10	313.0 yds.	38	242.2 yds.	44	155.2 yds.
Spring						
March						
April						
May	45	202.8 yds.	48	660.9 yds.	146	161.6 yds.
Summer						
June						
July						
August	19	704.4 yds.	86	506.6 yds.	408	165.7 yds.
Fall						
September						
October						
November	26	385.3 yds.	38	406.4 yds.	138	150.7 yds.
Over-all Total	100	356.6 yds. Average	210	475.9 yds. Average	736	161.5 yds. Average

In order to determine more precisely the significance of water as a constituent of scaled quail habitat, a more specific type of analysis has been employed here. This was the procedure suggested by Clark and Evans (1954). By means of this method, the degree to which the observed distances of scaled quail from water sources depart from that of a random distribution was measured.

The maximum distance which a quail could range from water sources was calculated for each of 16 radial compass directions. The average of these 16 distances yielded an average maximum cruising distance from each water source. This procedure was followed on the assumption that a quail might be expected to drink at the nearest place within reach. In essence, the end points of the 16 radiating lines being equidistant from adjacent water sources, when joined, encompassed a polygon that included the area of influence of that individual watering source.

A series of points randomly selected from a table of random numbers (Snedecor, 1946) was plotted within the area of influence of each windmill. A mean distance from each windmill was determined (Table 16). Scaled quail were found, on the average, nearer a water source than would be expected from a randomly distributed population (Table 16). This non-random distribution suggested clumping or grouping of scaled quail in relation to water which was in accord with the findings of Evans (1942) and Cole (1946). Whether

these quail were centering their activities near waterholes in order to utilize the water or other habitat necessities such as food or cover was unknown.

Table 16. Relation of Observed to Expected Mean Distance from Water on a Six Square Mile Study Area, Sandsage-Grassland, 10 Miles West of Boise City, Oklahoma, 1954-1956

Water Source	Expected Mean Distance from Water	Number of Observations	Observed Mean Distance from Water
1	699.6 yds.	12	69.6 yds.
2	550.0 yds.	96	157.3 yds.
3	888.8 yds.	3	331.8 yds.
4	750.2 yds.	141	183.7 yds.
5	748.0 yds.	84	411.2 yds.
6	941.6 yds.	60	346.9 yds.
7	754.6 yds.	8	362.0 yds.
Over-all Total	761.8 yds. Average	404	276.1 yds. Average

Pattern of Distribution

Winter Homestead Areas

During the winter, scaled quail assembled into large coveys which often included 200 or more birds. These large winter coveys cruised over restricted areas emphasizing the reality of the winter homestead. The number and distribution of winter covey homesteads seemed directly related to

the carrying capacity and the occurrence of scaled quail habitat. Such oriented spatial behavior was in agreement with Grinnell (1928) and Seton (1929) who declared that animals do not wander at random over the landscape. Dice (1952) stated that most animals spend their lives within closely limited areas. To date little information of this nature has been collected concerning the homesteads of scaled quail.

The majority of all relocations of marked quail of a covey observed during a winter period, November, 1954, to March 15, 1955, were made on a relatively small area. The boundary of this area, termed the winter homestead, was delimited by plotting on a map the points where these quail were seen. Additional observations of quail on four homesteads were made during the periods of November 23-27, 1955, December 23-January 5, 1956, and March 30-April 6, 1956. A total of 15 isolated observations were made of marked quail some distance away from their main coveys. Since these observations represented only 3 percent of 469 observations of marked quail, they were considered exceptional and thus were not included in the homestead boundary determination.

The average area of 10 scaled quail winter homesteads, 1954-1955, was 52.3 acres with a Standard Deviation of $\pm$24.3 (Table 17). The large Standard Deviation illustrated the broad variation in homestead areas.

Table 17. Scaled Quail Winter Homestead Areas and Covey Size, Cimarron County, Oklahoma, 1954-1955 and 1955-1956

No.	Study Area	Area in Acres of Winter Homestead		Number of Observations as Basis for Homestead Boundary		Size of Covey		Quail per Acre per Homestead		Habitat Type
		1954-1955	1955-1956	1954-1955	1955-1956	1954-1955	1955-1956	1954-1955	1955-1956	
1	Sterling Graham	76	X[1]	43	X[1]	30	X[1]	1:2.5	--	Short grass-high plains (Range land)
2	South of Sterling Graham Station 11	25	X	12	X	12	X	1:2.5	--	Short grass-high plains (Farm land)
3	J. R. Eiland	57	X	17	X	85	X	1:67	--	Pinyon-juniper
4	Boise City	24	X	11	X	22	X	1:1.09	--	Short grass-high plains (Farm land)
5	J. G. Mayhan	82	X	26	X	100	X	1:.82	--	Sandsage-grassland
6	L. Holloway	69	69	59	25	100	20	1:.69	1:3.45	Sandsage-grassland and farm land
7	H. Barnes	84	123	63	92	100	100	1:.84	1:1.23	Sandsage-grassland and farm land
8	E. Williams "A"	51	48	19	23	100	45	1:.51	1:1.02	Sandsage-grassland

Table 17--Continued

No.	Study Area	Area in Acres of Winter Homestead 1954-1955	Area in Acres of Winter Homestead 1955-1956	Number of Observations as Basis for Homestead Boundary 1954-1955	Number of Observations as Basis for Homestead Boundary 1955-1956	Size of Covey 1954-1955	Size of Covey 1955-1956	Quail per Acre per Homestead 1954-1955	Quail per Acre per Homestead 1955-1956	Habitat Type
9	E. Williams "B"	--	38	--	44	--	75	--	1:.51	Sandsage-grassland
10	E. Williams "C"	29	X	6	X	20	X	1:1.45	--	Sandsage-grassland
11	E. Tanner	26	X	14	X	50	X	1: .52	--	Pinyon-juniper-mesa
	Total	--	--	270	184	619	240	--		
	Average	52.3	69.7	27	46	62	60	1:.84	1:1.16	
	S.D.	± 24.3	± 33.0							

[1]Homestead boundaries and exact size of coveys were not determined during these periods.

During the two winters, 1954-1955 and 1955-1956, the quail coveys under study occupied homesteads of essentially the same areas. The average area was 68 acres in 1954-1955 and 69.5 acres in 1955-1956 for the same homesteads studied during the two consecutive winters. All ten homesteads studied in 1954-1955 were reoccupied in 1955-1956.

In 1954-1955, the five largest winter coveys, each containing 85 or more quail, had an average homestead area of 69 acres with a density of one quail per 0.71 acres. The other five coveys, those with fifty or fewer quail, each cruised over an average homestead 48 percent smaller in area, 36 acres, with a density of one quail per 1.33 acres (Table 17).

Coveys of scaled quail on winter homesteads, where grains were available, used an area which averaged 24 percent smaller than on those covey homesteads where no food was available from man's activities (Table 18). Coveys on five homesteads had access to grain near farm buildings and other cultural features used for shelter. The proximity of food and shelter apparently was a factor in curtailing their cruising radius. This was in accord with Errington and Hamerstrom (1936) who commented that "a covey does not move about greatly unless it has to. Hunger is a powerful driving force and may. . . lengthen the cruising radius of an established covey in its foraging for food." Those homesteads, with supplemental food available, supported a

population nearly one and one-half times as dense per occupied homestead as those coveys without this extra food.

Table 18. Winter Covey Homestead Area and Density of Scaled Quail with and without Supplemental Feeding, Cimarron County, Oklahoma, November, 1954 - April 15, 1955

Number of Winter Homesteads	Average Area of Homestead, and Quail Density with Supplemental Food	Average Area of Homestead, and Quail Density without Supplemental Food
5	57 acres - 1 quail/.8 acres	------
5	------	74 acres - 1 quail/ 1.4 acres

Information on the area occupied by scaled quail in adjacent parts of its range during the winter season was limited. Figge (1946) reported that scaled quail in southeastern Colorado usually could be found within a cruising radius of one and one-half miles of their roosting site during the winter months. The extreme diameter of the winter homesteads studied in Cimarron County was one mile on the J. G. Mayhan sandsage-grassland study area, or considerably less than the cruising radius found in the Colorado study. Russell's (1932) statement that a covey of scaled quail in northeastern New Mexico will cruise over three quarters of a mile during a winter day's activity agreed more nearly with the findings of this study.

Adjacent winter covey homesteads, Figures 20 and 21, determined during two consecutive winters will be considered in detail to explain some of their interrelationships and year to year changes.

Covey Homestead No. 6.--Two hundred and five quail, 174 scaled quail and 31 bobwhites, were trapped, banded, and returned on this homestead (Figures 20 and 21) during the period from September 21, 1954, to April 1, 1956. The winter homestead area of Covey No. 6 remained the same, 69 acres, from one year to the next, although there was a reduction in covey size from 100 to 20 birds on this homestead (Table 17). Possibly, this reduction in covey size in 1955-1956 may be accounted for by hunting disturbance and the lack of severe winter weather which lowered the tendency to concentrate.

Covey Homestead No. 7.--Two hundred and sixty-three scaled quail were trapped, banded, and returned on this homestead (Figures 20 and 21) during the period from September 26, 1954, to April 9, 1956. The area of this homestead increased from 84 acres, 1954-1955, to 123 acres in 1955-1956, although the covey size remained constant at 100 during both winters. This covey extended the east side of its homestead to include a heavy, tall stubble of grain sorghum which afforded an improved feeding area. The western boundary of Covey Homestead No. 7 was essentially the same during both winter seasons.

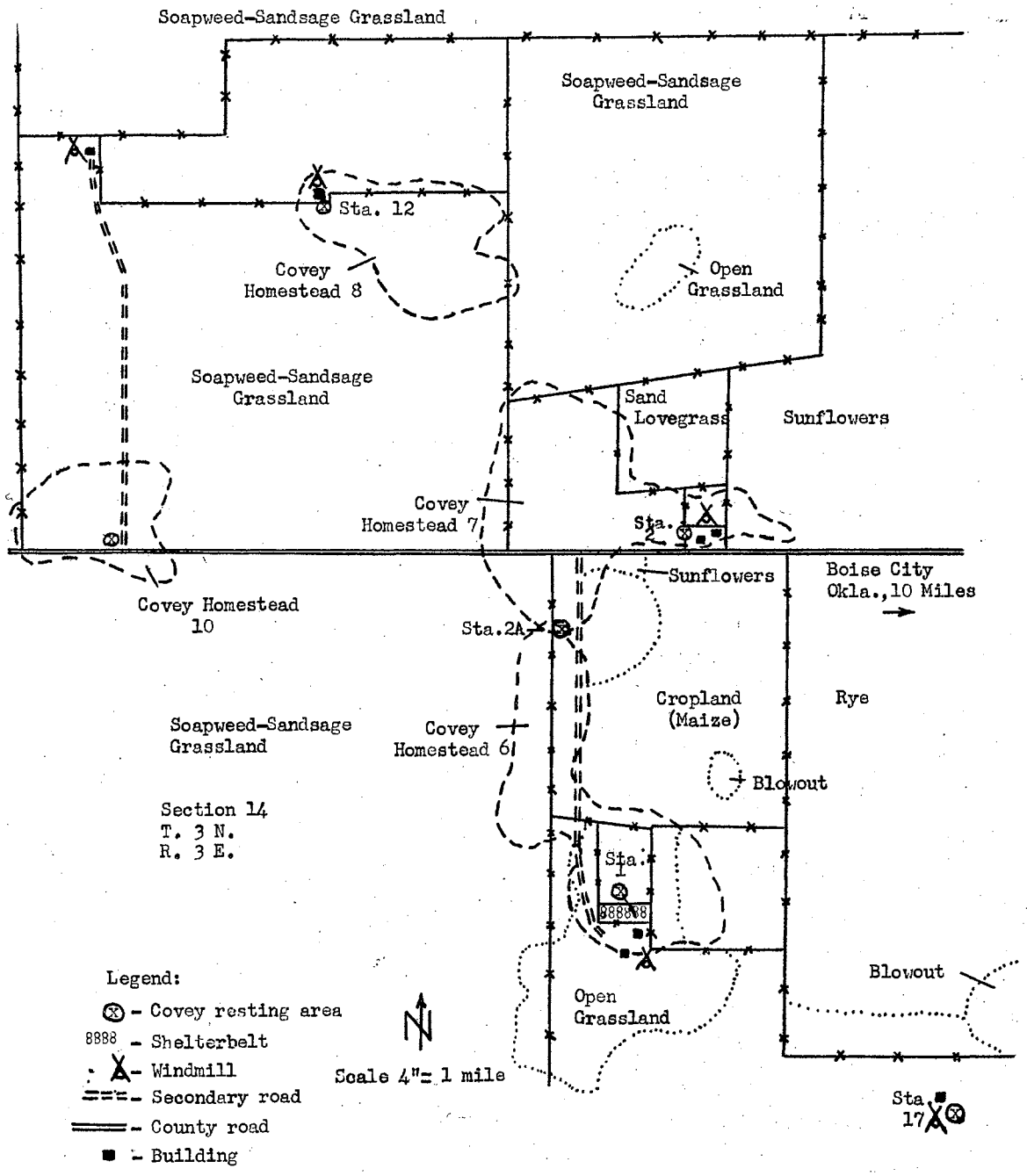


Figure 20.— Scaled quail winter covey homesteads, 1954-1955, Holloway-Barnes-Williams Study Area, Cimarron County, Oklahoma

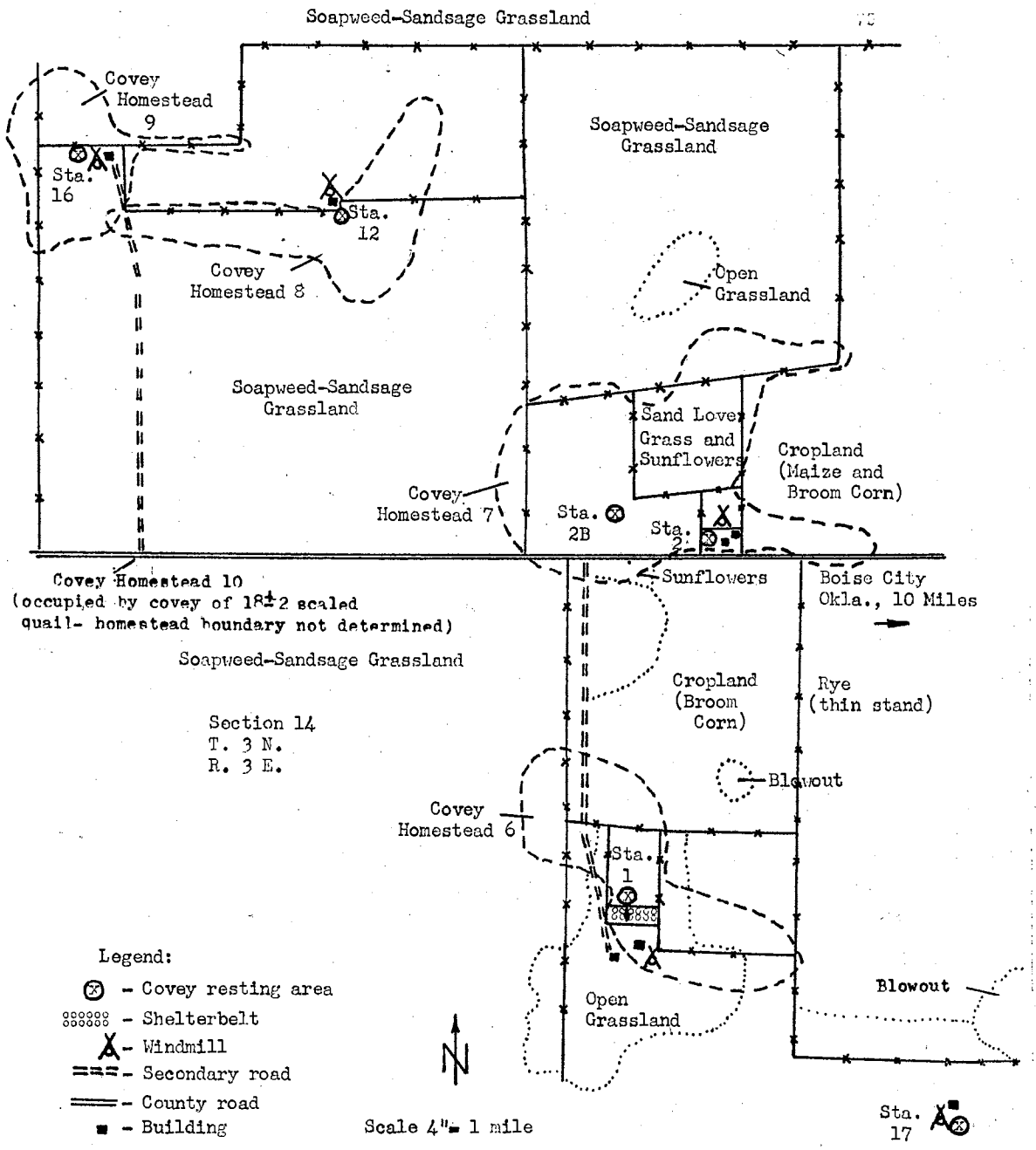


Figure 21.-- Scaled quail winter covey homesteads, 1955-1956, Holloway-Barnes-Williams Study Area, Cimarron County, Oklahoma.

The southern extension of this homestead boundary was less in 1955-1956 than in 1954-1955. The main change in this part of the homestead was the removal of the combine from Station 2A.

Covey Homestead Nos. 8, 9.--Covey homestead No. 8 decreased slightly in area from 51 acres in 1954-1955 to 48 acres in 1955-1956. A similar decrease, which occurred in covey size from 100 to 45 quail, coincided with a density decrease of one bird per 0.51 acres to one bird per 1.07 acres. Several members of Covey 9 were banded originally at Station 12 as members of Covey 8 (Figures 21 and 22). Throughout the 1955-1956 winter study period, grain sorghum bundles were being hauled to and unloaded at Station 12. Perhaps this repeated disturbance and eviction from their resting area were factors contributing to the movement of some quail from Homestead 8 to Homestead 9. Homestead 9, 38 acres in extent, was occupied by 75 scaled quail in 1955-1956 but was vacant the previous winter, 1954-1955. A slight overlap in boundaries between Homestead 8 and Homestead 9 was evident (Figure 21).

Interchange between Winter Coveys.--A limited amount of quail interchange between established winter coveys was evident (Table 19). Such behavior by quail was not unique to this study.

Table 19. Summary of Recaptures and Reobservations Illustrating Scaled Quail Inter-covey Movements Between Two Winter Homestead Areas, December, 1955, Sandsage-Grassland Study Area, 10 Miles West of Boise City, Cimarron County, Oklahoma

Aluminum Band Number	Covey Homestead Where Originally Trapped	Date Banded	Covey Homestead Where Recaptured or Reobserved	Date Recaptured or Reobserved	Age and Sex
2213	7*	12/23/54	6	1/3/55	Juvenile
			6	1/16/55	Female
			6	1/18/55	
1201	7	12/25/54	6	1/4/55	Adult Female
2007	6	8/22/54	6	12/14/54	Juvenile
			7	12/22/54	Male
			7	12/24/54	
1111	6	12/3/54	7	12/23/54	Juvenile
			7	12/27/54	Male
2086	6	9/27/54	6	12/3/54	Juvenile
			7	12/23/54	Female
			7	12/25/54	
			7	1/17/55	
1116	6	12/3/54	7	12/23/54	Juvenile
			6	12/31/54	Male
			6	1/2/55	
			6	1/5/55	
			6	1/16/55	
			6	3/12/55	

*See Figure 20 for location of homesteads

Figure 22.--Station 12, covey resting site, Homestead No. 8, Elmer Williams Ranch, sandsage-grassland, 11 miles west of Boise City, Oklahoma, Cimarron County, August 15, 1955.

Similar intercovey movements based on the observation of banded birds have been reported for scaled quail in west Texas (Wallmo, 1956a); for bobwhite quail in the southeastern United States (Stoddard, 1931), in Iowa and Wisconsin (Errington and Hamerstrom, 1936), in Texas (Lehmann, 1946), in Kentucky (Pierce, 1951), in Virginia (Harvey, 1953), in Kansas (Robinson, 1957); and for valley quail in California (Price, 1931, and Sumner, 1935).

One particularly interesting case of a temporary shift from one covey to another involved scaled quail No. 1116

(Table 19). This bird, a juvenile male, was trapped as a member of Covey No. 6 on December 20, 1954. On December 23, this quail was retrapped after it had joined the covey inhabiting Homestead No. 7. By December 31, 1954, No. 1116 had returned to Covey Homestead No. 6, a movement of three-quarters of a mile. Here it was reobserved and recaptured several times thereafter.

On January 3, 1955, a marked juvenile female quail, No. 2213, a member of Covey 7, was observed at 2:30 p.m. with members of Covey 7. By 4:30 p.m., this quail had joined Covey 6, a quarter of a mile distant. Scaled quail No. 2213 was reobserved on several occasions subsequently with Covey 6 (Table 19).

Overlap of Winter Homesteads.--In this study, two cases of homestead overlap were apparent (Figures 20 and 21). Wallmo (1956a) observed overlap in two of the six scaled quail winter homesteads that he studied in west Texas. McLean (1930) portrayed overlap on a map depicting mountain quail covey homesteads in California. Valley quail homesteads in California also overlapped (Sumner, 1935). Stoddard (1931), Lehmann (1946), Murphy and Baskett (1952), and Agee (1957) observed similar spatial behavior by bobwhite quail coveys.

Trapping Station 2A (Figure 20) was beside a combine in the area of overlap between Homesteads 6 and 7. At this covey resting site, color-marked quail of both Covey 6 and 7

were reobserved and recaptured. The degree of temporary intermingling was illustrated in Table 20. When this combine was moved on January 8, 1955, no further use of this area, which had been common to both coveys, was observed.

Table 20. Composition of a Scaled Quail Group Visiting Trapping Station 2A, 10 Miles West of Boise City, Cimarron County, Oklahoma, Winter, 1954-1955

	Number of Recaptures from Covey Homestead No. 6	Number of Recaptures from Covey Homestead No. 7
12/27/54	8	0
1/1/55	6	0
1/2/55	2	0
1/3/55	4	0
1/4/55	4	0
1/5/55	1	0
1/6/55	5	3
Subtotal	30	3
Additional marked quail reobserved but not recaptured at Station 2A	18	29
Total	48	32

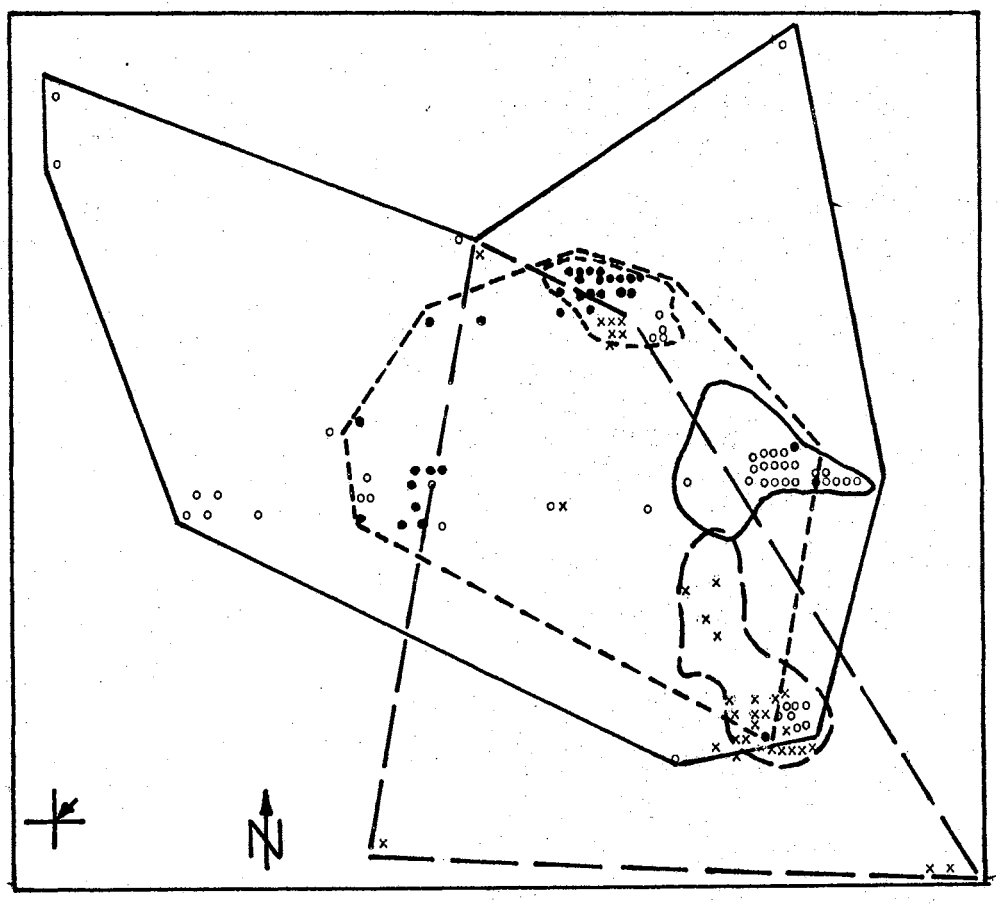
Summer Homesteads of Scaled Quail

The winter scaled quail homesteads mentioned previously were a part of a larger area, termed the summer homestead. The period March 1 to April 15 in the early spring was

characterized by an increase in fighting among males and intolerance between mated pairs within the winter covey. Shortly thereafter, the large winter coveys began to split up into smaller groups and gradually into mated pairs prior to the nesting season. The extremes of movements of the color-marked quail from each of three winter coveys during the period April 15 to September 15 were plotted on a map to delimit the boundaries of the three summer homesteads occupied by members of each winter covey. The lack of an adequate number of reobservations of the summer activities of the members of some winter coveys caused the restriction of summer homestead determination to only three homesteads. Available information on summer homestead acreage and location is presented in Table 21 and Figure 23. The acreages listed in Table 21 represented the minimum areas over which the quail cruised. Some banded quail on their summer homestead may have been overlooked, while others may have lost their colored markers.

Table 21. Summer Homestead Areas for Coveys of Scaled Quail, Sandsage-Grassland, Cimarron County, Oklahoma, 1955

Study Area	Covey Number	Number of Observations of Marked Birds	Acres in Annual Homestead
Lloyd Holloway	6	36	1,220
Henry Barnes	7	51	2,180
Elmer Williams	8	31	720



Legend: Scale 2"= 1 mile

— — Homestead boundaries of Covey 6 (small area = winter homestead; large area = summer homestead)

x Location of observation of color-marked quail trapped on winter homestead of Covey 6

——— Homestead boundaries of Covey 7 (small area = winter homestead; large area = summer homestead)

o Location of observation of color-marked quail trapped on winter homestead of Covey 7

– – – – Homestead boundaries of Covey 8 (small area = winter homestead; large area = summer homestead

• Location of observations of color-marked quail trapped on winter homestead of Covey 8

Figure 23.-- Summer homestead boundaries of three coveys of scaled quail, April 15, 1955 - September 15, 1955, based on all relocations of individuals trapped and marked on winter homesteads, sand-sage-grassland, 10 miles west of Boise City, Cimarron County, Oklahoma.

A few of the marked quail that were reobserved (Figure 23) were seen at intervals throughout the summer (Table 22). A detailed examination of these repeated observations provided information on quail movements within their summer homesteads (Table 22 and Figure 24).

Male No. 1205 and female No. 2247 first were trapped and banded at Station 2 (Figure 24) on December 20, 1954. They were reobserved several times thereafter on their winter homestead as members of Covey No. 7 (Figure 20) up until April 20, 1955. At this time they were reobserved as a mated pair while feeding three-eighths of a mile outside of the west boundary of their previous winter homestead. On August 25 and August 29, 1955, this pair was recaptured and later reobserved at Station 12 (Figure 24) with 11 three-quarter grown young. On September 7, 1955, the same pair had returned with nine surviving offspring to Station 2, the site where they were captured originally.

Adult male No. 1195 was banded at Station 2 (Figure 24) on December 23, 1954. This male was reobserved on five occasions as a member of Covey No. 7. No. 1195 was recaptured April 5 at Station 2. This bird was reobserved as a whistler near Station 16 (Figure 24) on May 26, 1955. On July 14, 1955, quail No. 1195 was seen in the company of an unbanded female at a point one and one-fourth miles west of Station 16. This quail was last viewed August 23, 1955, 100 yards south of the place where it had been seen previously on July 14.

Table 22. Record of Movements of Marked Pairs of Scaled Quail, 10 Miles West of Boise City, Sandsage-Grassland, 1954-1955, Cimarron County, Oklahoma

Quail Number, Age, Sex	Observation Number	Date	Comments
No. 1205 Adult male	1*	12/20/54 -4/20/55	Point of original capture on winter homestead and duration of stay
No. 2247 Adult female	2	12/20/54 -4/20/55	Limit of known westward movement on winter homestead as member of a winter covey
	3	7/1/55	Flew east 100 yards when disturbed - feeding
	4A	8/25/55	Pair and 11 young 3/4 grown
	4B	8/29/55	Pair and 11 young 3/4 grown
	5	9/7/55	Return to winter homestead 2 + 9 young (loss of 2)
		9/8/55	Reobserved same place
		9/10/55	Reobserved same place
No. 1195 Adult male	6	12/23/54 -4/1/55	Point of original capture
	7	12/23/54 -4/1/55	Limit of known westward movement on winter homestead as member of winter covey
	8	5/26/55	Whistler
	9	7/14/55	Paired
	10	8/23/55	Covey of 4 adults + 50 young 3/4 grown
No. 2233 Adult male	11	12/20/54 -3/24/55	Point of original capture

Table 22--Continued

Quail Number Age, Sex	Observation Number	Date	Comments
	12	4/1/55	Recapture
	13	7/2/55	Feeding 9:30 a.m. 6:45 p.m.
		7/8/55	Whistling
		8/17/55	2 adults and 10 young 1/2 grown
		9/8/55	30 $\pm$ 3
No. 2317 Adult male	14	4/1/55	Point of original capture
	15	4/8/55	Covey of 7
	16	4/27/55	Pair feeding 100 yards north of cattle guard
	17	5/21/55	Pair feeding 7:45 a.m.
	18	8/23/55	Pair loafing 10:30 a.m.
		8/26/55	Feeding by self
	19	8/27/55	Pair plus 6 young one month old
	20	8/30/55	Pair + 4 young (loss of 2)

*Location plotted on Figure 24

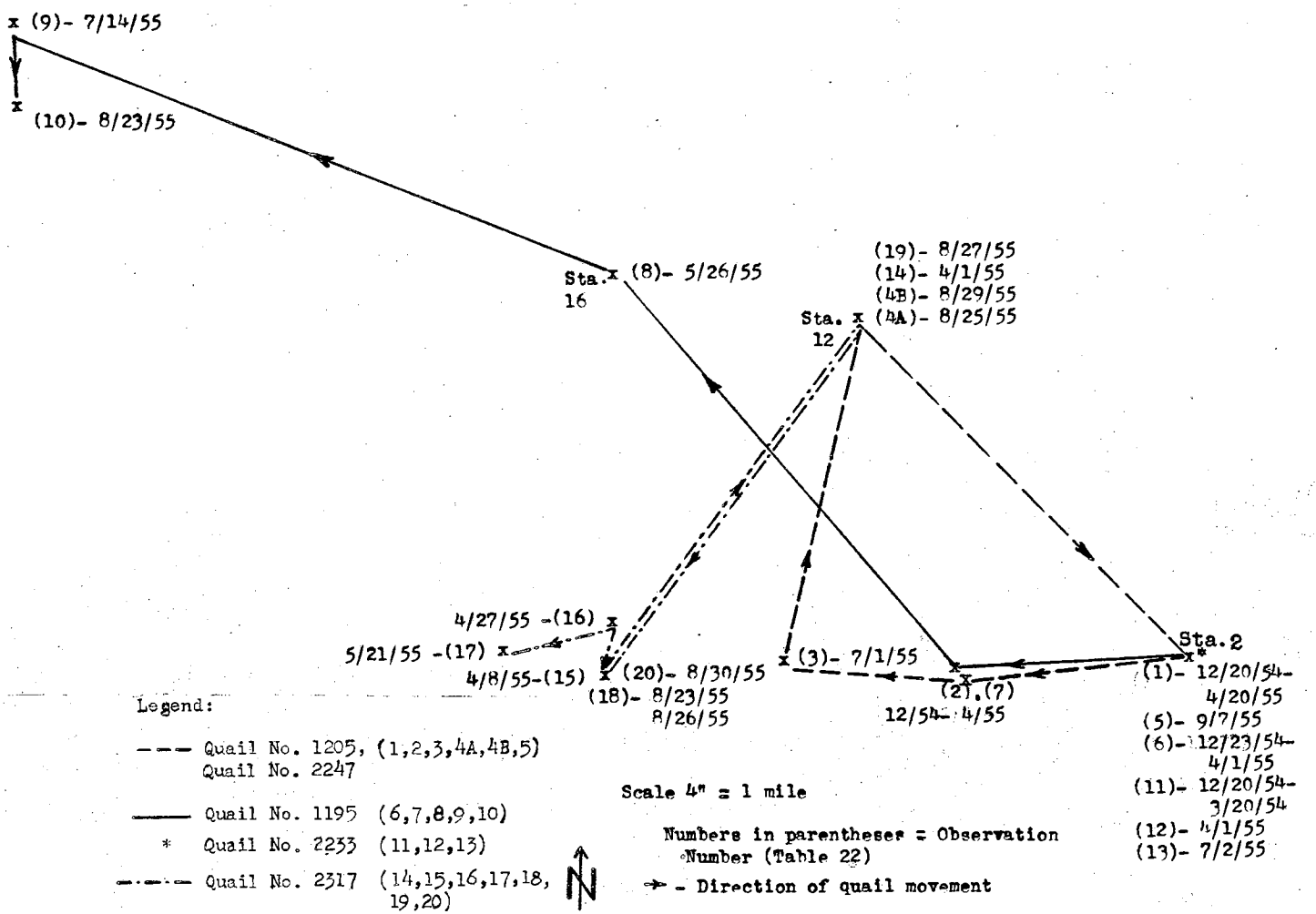


Figure 24.-- Movements of some marked scaled quail, sandsage-grassland study area, Cimarron County, April, 1954-September, 1955

Unlike the three previously mentioned breeding quail, No. 2233, a male, was not seen outside of its winter homestead environs. This bird was sighted at Station 2 (Figure 24) while whistling on July 2, 1955, and nearby with young on August 17, 1955. On September 8, 1955, No. 2233 was seen resting with 30 other quail at Station 2 within Homestead 7 (Figure 20).

Quail No. 2317, a male, was first captured at Station 12 (Figure 24) April 1, 1955. Seven days later, April 8, this bird was found three-quarters of a mile southwest at a cattleguard near the entrance road into the Elmer Williams ranch. Three times subsequently, No. 2317 was watched with his mate in this locality. By August 27, 1955, the pair with six young had returned to Station 12. Three days later the family group was present again at the cattleguard.

DISCUSSION OF RESULTS

Life-Form Concept and the Importance of Cover as a Necessary Component of Scaled Quail Habitat

During the present study, scaled quail were found in certain restricted habitats in the three predominating vegetation types in Cimarron County. This behavior suggested that there was some common denominator or habitat element, common to each of these three vegetation types, making these areas suitable for scaled quail.

Topography did not appear to be a factor limiting distribution since both flats and precipitous slopes were inhabited by the birds. The physiographic nature of the landscape is one of the factors that has a bearing on scaled quail distribution since it directly affects the growth-form of the vegetation. The ravines and canyons which dissect the high plains, perhaps because of more favorable moisture conditions, favored the growth of plants of shrub life-form.

Plants having a shrub growth-form and offering overhead cover were used frequently by scaled quail (Table 5). These habitat situations provided the overhead shelter apparently essential to quail welfare (Stebler and Schemnitz, in press).

The taxonomic groups of plants used by scaled quail for cover varied in the three main vegetation types in Cimarron County. However, the structure of the vegetation used for cover, the shrub life-form, was found in all the areas occupied by scaled quail that were studied. The inclusion of numerous taxonomic plant entities into one or more collective life-form groups seems to have utility for evaluating habitat on a more understandable basis.

Where suitable shrub cover was lacking or very restricted, the birds made use of various cultural features (Table 5). Both natural and cultural niches furnished overhead cover which seemed to be valuable for shade, resting areas, and refuge. Together these two habitat niches may be regarded as essential components of the regional habitat of scaled quail in Cimarron County. In the three vegetation types, it is suggested that it was the presence of one or both of these niches that provided suitable habitat for scaled quail. Habitat niches, when based upon the observed use by an animal, can be considered as the place elements constituting the habitat of a species.

Individual covey homesteads were relatively constant in area from November to March. If a winter food shortage were a critical factor in the welfare of scaled quail, the birds might be expected to range over larger areas during the winter than at other seasons of the year to satisfy their food needs. This was not the case. During the winter

months as the season progressed, seed supplies might be expected to diminish as they were consumed by various rodents and birds. Baumgartner (1946) found this to be the situation with sunflower and western ragweed seed during the winter. However, during the winter, the scaled quail cruising radius did not change noticeably.

Scaled quail coveys in the winter spent much of their daytime resting period at cultural features. In many instances, no supplementary food was present at these sites. These cultural features seemed to be used primarily for their cover benefits.

Mixed forbs served as cover in only 6.4 percent of the observations of habitat-use by scaled quail (Table 5). Herbaceous growth, due to its short-lived character, had only limited seasonal value as cover. Areas having only herbaceous cover were not suitable for scaled quail habitation on a year-round basis. Such areas were found mainly in the open grassland and cultivated land of the short grass-high plains type. This abundance of open herbaceous cover and general lack of protective overhead cover may have been a factor that accounted for the restricted and localized distribution of scaled quail in that type.

The habitat of a species with a broad geographic range can be analyzed on a comparative basis more realistically when considering physiognomic units, such as life-form, which tend to remain uniform. Taxonomic plant units tend

to vary from region to region. Peterson (1942), Brecher (1943), and Pitelka (1947) have pointed out the limitations involved in a classification of bird distribution according to life zones or biomes. Employment of the life-form approach may allow a clearer understanding of bird and mammal habitat requirements and distribution.

Classifying habitat niches in a physiognomic sense further allows an evaluation of the relative importance of natural as well as cultural niche components of a habitat. These components can be studied from the viewpoint of what the niche provides for the animal.

This approach to habitat delineation seems to have merit as a practical wildlife management tool. Harris (1952) studied two races of prairie deermice (Peromyscus maniculatus) and found that he could synthetically create habitat for these mice. Harris concluded that the prairie race exhibited a preference for and accepted an artificial grass habitat, while the forest race preferred to use an artificial tree trunk habitat. When the essential habitat niche requirements of a species are determined, suitable additional cultural features might be provided to supplement those niches that were lacking. This approach has been tested for wildlife species only to a limited extent. Brush piles for cottontail rabbits, nest boxes for squirrels, wood ducks, and raccoons, and artificial roosts for California quail are examples of the application of this principle as a

technique when certain habitat requirements have been defined clearly.

The Homestead Concept in Relation to Population Behavior

Scaled quail were not distributed uniformly over the landscape. Instead, the birds were restricted to certain select living areas, or homesteads. On these delimited areas, the requirements of life were realized. Linsdale (1957) has stated that a species was seldom adapted to all the elements of habitat that occurred in a region but more often was affected only by a small segment of the range. Since scaled quail homesteads represent the actual area used by the birds, an analysis of the features of these areas used by the quail made possible an adequate description of the scaled quail habitat in Cimarron County.

A homestead represents a space unit occupied by a group of animals and is a means whereby the members of a species distribute themselves at intervals in their environment. Ten scaled quail winter homesteads averaged 52.3 acres in size (Table 17). Due to the space requirements associated with each homestead, an area inhabited by scaled quail can support only a restricted number of homesteads. Within each homestead, a population limit is imposed by the requirements of the individual quail for food, shelter, and space.

Therefore, the homestead as a unit also may be considered as a population regulatory mechanism.

Winter homestead size varied from 24 to 84 acres (Table 17). The over-all scaled quail population density was one quail per 0.84 acres on the winter homesteads in 1954-1955 and one quail per 1.16 acres on four winter homesteads in 1955-1956. Homestead area varies from place to place and year to year in accordance with changes in the distribution and abundance of essential shelter, food, nesting niches in the habitat, and the number of birds in the covey. Some variation, as might be expected, was reported for the average homestead area of various species of quail (Table 23). There was a notable variation in winter homestead area and population density of scaled quail from two parts of the range in Oklahoma and Texas (Table 23). Bobwhite and scaled quail winter homesteads in Oklahoma were somewhat similar in average size, but the bobwhite population density was lower on those homesteads studied.

The size of winter homesteads studied during two consecutive winters was relatively constant, although boundaries fluctuated slightly from one year to the next. No important changes in land-use practices and homestead niches were apparent. Fluctuations in the size of a homestead from year to year can be expected to be dependent upon changes in the carrying capacity of the homestead areas. All homesteads studied were occupied both years.

Table 23. Comparison of Average Winter Covey Homestead Areas for Scaled, Gambel's, Valley, and Bobwhite Quail

Species	Number of Homesteads Determined	Average Area of Homestead in Acres	Maximum Size	Minimum Size	Average Number of Acres per Quail of Occupied Range	Investigator
Scaled (Oklahoma)	10	52.3	84	24	0.84	Present study (1954-1955)
Scaled (Texas)	5	360	592	175	10.1	Wallmo (1956a)
Gambel's (Nevada)	?	20*	--	--	--	Gullion (1956)
Valley (California)	6	25	--	--	--	Price (1931)
Valley (California)	4	26	45	19	0.91	Emlen (1939)
Bobwhite (Missouri)	9	24	35	8	--	Murphy and Baskett (1952)
Bobwhite (Oklahoma)	13	49.4	77	25	3.41	DeArment (1950)
Bobwhite (Texas)	10	24	--	--	--	Lehmann (1946)

*Based on average radial movement of 530 feet

This traditional occupation of the same homestead area may be considered to have an important bearing on stabilizing, within limits, the population level of units of habitat.

Leopold (1933) has defined carrying capacity as the density limit of animals that a specific area will support at a given time. Leopold stressed food as a major factor limiting carrying capacity. The homestead area is useful as an expression of carrying capacity since it expresses the degree of use of an area by a group of quail to satisfy its needs. All the factors influencing an animal's way of life, not only food, are brought into focus and can be recognized on homestead areas. Errington (1956) suggested that many species are sensitive to slight environmental changes. Continued long-term studies may allow additional correlation between population variation and change in habitat niches.

When the study of an animal's habitat is limited only to the homestead area, the unused interhomestead spaces are not considered. This method results in an economy of time and effort. Considering winter homesteads only, there was one scaled quail per 1.11 acres on 10 study areas. If the density of the same number of scaled quail is calculated on an over-all acreage basis, one scaled quail was present on 12.9 acres. The density of scaled quail per unit of occupied homestead is a more realistic expression of density than one which includes unused as well as used area. For the latter case, no true estimate can be made of the

proportion of the over-all area that actually is occupied by scaled quail. Therefore, the homestead may be considered as a basic unit for establishing a habitat improvement program since the homestead delineates an area on which the various habitat niches can be measured. The quality of these niches then can be improved. New homesteads can be established by duplicating the niches previously determined by the analyses of occupied homesteads.

Scaled quail on their homesteads seemed to follow a relatively constant seasonal routine traversing similar paths each day from early morning feeding and watering to midday resting, evening feeding, and roosting. The homestead has survival value to the animals inhabiting it since the location of vital niches, such as food and shelter, presumably is known to the animal inhabitants. Therefore, these niches can be used with a minimum expenditure of time, effort, and risk. The homestead may have an important bearing on quail survival during adverse times. The birds are oriented with regard to ease of finding and satisfying their basic living needs because of an intimate association with the various habitat niches on their homesteads. Improved survival on homesteads may account for the evolution of the homestead habit of wild animals by the process of natural selection. It is possible that those individual animals that failed to settle on homesteads may not have survived.

A homestead is an area where an animal or social group lives. Each animal or social group is oriented to a particular area of ground. The attachment of animals to a homestead may be considered in some respects to be a type of homing behavior.

The restriction of animals to familiar areas also may tend to allay friction and intraspecific strife, thereby promoting community stability. No intercovey discord was observed between the scaled quail coveys occupying the winter homesteads studied.

MANAGEMENT SIGNIFICANCE OF THIS INVESTIGATION

Manipulation of the Environment

Maintenance and improvement of the habitat of an animal are currently two of the main methods employed in wildlife management. These techniques strive to influence the quality and quantity of food and shelter available to the wildlife species concerned. There was no indication from this study that a lack of food was a factor limiting the increase and distribution of scaled quail in Cimarron County. During the winter period, these birds remained closely associated with the protective cover provided by shrubs and cultural features (Figures 16 and 17). The restricted distribution and abundance of shrub cover, especially in the short-grass and sandsage-grassland types, suggested the practicability of supplying additional cover.

The relatively small winter homesteads, averaging 57 acres (Table 17), would allow several management units per section of land with a potential high rate of quail increase per farm or ranch.

Cover Development

Two approaches to cover improvement, immediate and long term, are available to the wildlife manager.

Maintenance of Existing Vegetation.--One type of immediate cover improvement would be the fencing of small clumps of skunkbush and four-winged saltbush (Atriplex canescens) that grow at scattered places over the rangeland. Often these clumps were browsed and trampled to such an extent that they provided only limited cover for scaled quail. Fencing these deteriorated shrub patches would allow them to recover from grazing effects and provide quail escape, resting, and nesting cover.

Small gullies often began on sloping rangeland. Sand blowouts were a problem in the sandsage-grassland type. Once started, these gullies and blowouts usually became larger and deeper, making their control difficult. One possible approach to this problem was the construction of a fence around the area as an aid in the restoration of remnants of native vegetation. Vegetation protected from livestock would tend to become established, curtailing the erosion and providing wildlife cover. Allan and Sime (1942) found scaled and bobwhite quail inhabiting five of 10 such small fenced areas. The spreading of brush (Figure 25) has been used as a method of stabilizing dunes and blowouts which added quail cover as well.

Artificial Cover.--The propensity of scaled quail to use artificial structures suggested the feasibility of constructing additional cultural features in the form of brush, post, and board piles (Figure 26), platforms, old

machinery, and junk to be placed in waste areas such as blowouts, gullies, and fence corners.

Figure 25.--Brush rip-rap for wind erosion control and quail cover along a sandy road shoulder, Gene Howe Game Management Area, Texas Game and Fish Commission, two miles north, six miles east of Canadian, Texas, May 7, 1957.

The construction of artificial cover in vacant areas of potential range would create new homesites for juvenile scaled quail to establish themselves and tend to create a more uniform quail distribution and more complete use of quail range.

Figure 26.--Lumber pile placed by Mr. Lloyd Holloway in pasture and used for cover by scaled quail. Trapping station 2B, 10 miles west of Boise City, Oklahoma, December 25, 1955.

Six brush shelters made from Christmas trees (Figure 27) collected by the Boise City Boy Scouts were put out January 3, 1955, on two study areas west of Boise City. Three of these brush shelters were used within three days after placement. The other three were scattered by the force of high winds.

Lehmann (1939) successfully installed pole and brush shelters for bobwhite quail cover management in south-central Texas. Kessel (1921) and Emlen and Glading (1945)

observed valley quail frequenting brush piles and brush shelters.

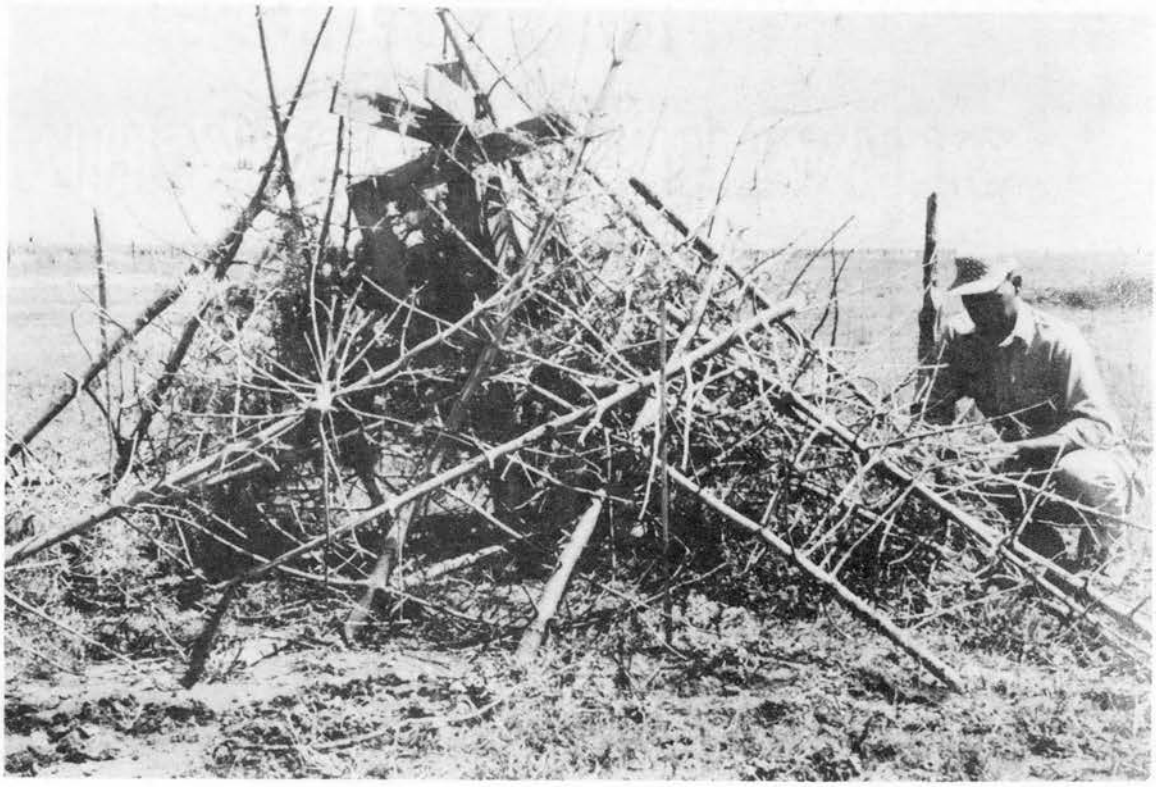


Figure 27.--Christmas tree brush pile for quail in open grassland, two miles east and two miles north of Boise City, Oklahoma, D. Machotcha Farm, August, 1956.

Frary (1957) observed in eastern New Mexico that "Brush shelters appear to be a factor in determining the presence of this bird (scaled quail) when no other forms of cover exist. Quail have not been observed at three units which provide food and water but no shelter." Frary (1957) found a tepee brush shelter to be adequate for scaled quail (Figure 28). Kinghorn and Hoover (1954) reported that 100 scaled quail released near Ft. Collins in north-central

Colorado were using brush shelters placed by sportsmen for winter cover. Steele (1957) concluded that the protection afforded to scaled quail by large brush piles in Cimarron County was a factor in decreasing mortality during a severe blizzard, March 22-24, 1957.

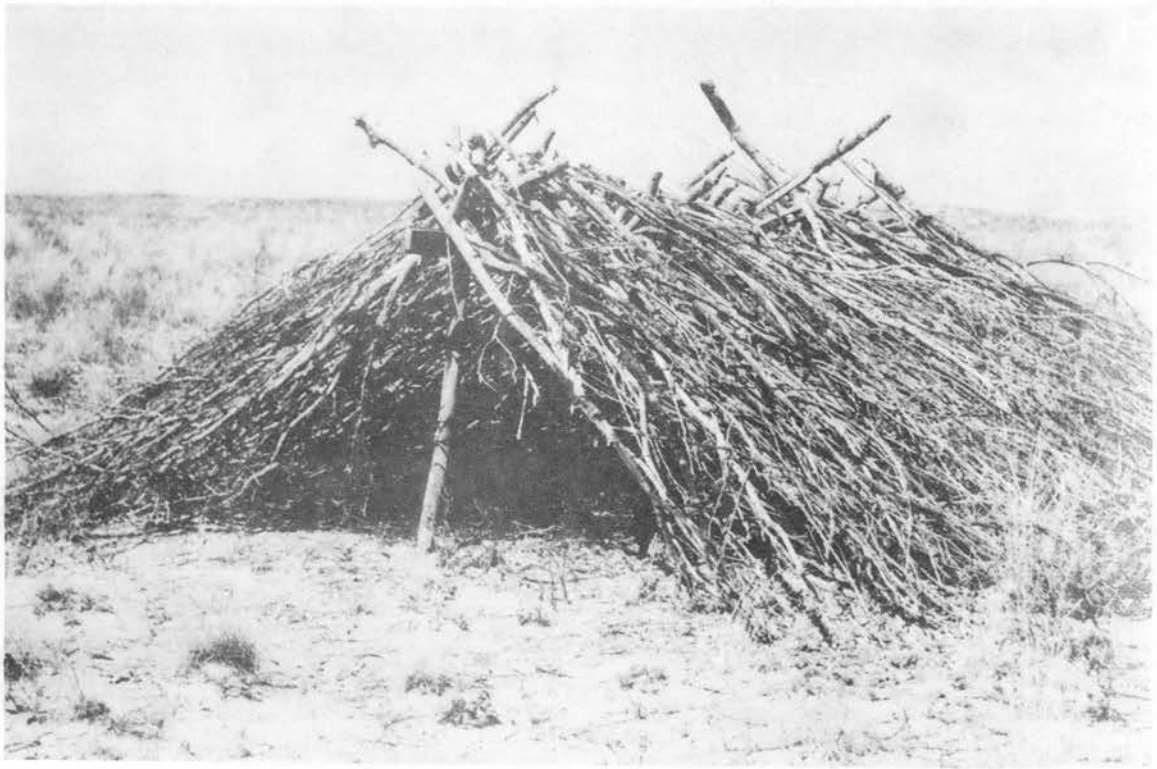


Figure 28.--Brush shelter of the tepee type on lesser prairie chicken restoration tract but used principally by quail, northeastern New Mexico (courtesy of Ladd Frary, biologist, New Mexico Department of Game and Fish).

Kinghorn and Ellis (1956) observed 19 scaled quail near Ft. Collins, Colorado, during the winter of 1955 seeking protection from wind and snow under a lean-to shelter. Their suggested dimensions for this type shelter were 16 feet by 24 feet sloping from the ground upward to

approximately six feet in height with the sloping side facing the wind. Nelson (1956) advocated mechanical devices to supplement woody cover as an expeditious means of providing less expensive woody cover. Nelson suggested deflecting the wind upward by using a sloped rather than a vertical barrier to avoid snow accumulations.

Mechanical cover devices have many desirable characteristics. They are durable, of low cost, and require little or no maintenance. Another good attribute is the small size area required as compared to the area needed for a vegetative cover plot. This is an important factor where land values are high. Artificial cover in general is acceptable to wildlife and landowners and is adaptable to installation by sportsmen. Mechanical structures may be used almost immediately by game birds, while trees and shrubs require at least several years to become well established. Furthermore, during drought periods, woody vegetation is difficult to establish. A more practical way of creating cover would seem to be the installation of cultural features.

Wildlife Plantings.--Trees and shrubs have been planted by some Cimarron County landowners for shelterbelt purposes as well as the beautification of their property. These plants often have furnished shelter for wildlife. The Oklahoma Department of Wildlife Conservation has provided shrubs and trees for wildlife plantings free of charge to

interested landowners. The success of these plantings has been low in the Oklahoma Panhandle during the recent dry period. Most of the plants available for planting were suitable for planting in eastern Oklahoma under more mesic conditions than existed in Cimarron County. Native trees such as pinyon pine, white juniper, ponderosa pine (Pinus ponderosa), and thick-leaved hackberry, being adapted to the xeric conditions, might be planted with less risk. Native shrubs such as tree cactus, sand plum (Prunus watsonii), skunkbush, and wild currant were other possible choices for plantings. Campbell (1952) recommended transplanting tree cactus as a means of providing cover for scaled quail in New Mexico. Because of their resistant qualities, additional trees, such as Russian olive (Eleagnus angustifolia),[1] honey locust (Gleditsia triacanthos),[2] Russian mulberry (Morus alba var. tatarica),[1,2] New Mexico locust (Robinia neomexicana), Chinese elm (Ulmus parvifolia),[2] Siberian elm (Ulmus pumila), and such shrubs as bumelia (Bumelia spp.), desert willow (Chilopsis linearis), fortune fontanesia (Fontanesia fortunei), winterberry (Euonymus bungeanus), New Mexico forestiera (Forestiera neomexicana), Osage orange (Maclura pomifera),[2] sand cherry (Prunus tomentosa), Kashgar tamarix (Tamarix hispida), and chaste-tree (Vitex

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[1]Seed eaten by scaled quail.

[2]Presently available as planting stock from the Oklahoma Department of Wildlife Conservation.

agnus-castus) were considered suitable for wildlife plantings in Cimarron County by Burnham and Johnson (1950), Johnson (1954), Wells (in litt., March 6, 1957), and Johnson (in litt., June, 1957).

Plantings should be made during the periodic rainy periods between the drought years to utilize increased available moisture and enhance survival, or provisions should be made for watering until well established. The Texas Game and Fish Commission has been using two-year-old planting stock approximately three feet in length for Panhandle area plantings. Increased survival was anticipated from these larger plants since they were better able to resist mechanical damage from rabbits and sand storms. A deeper root development allowed better use of the limited soil moisture.

Many deciduous tree species need topping to encourage a bushy growth-form (Figure 29). In many tree plantings (Figure 30), the lower tree branches were trimmed. These plantings had only minor value for winter quail cover.

Status of the Population

The spatial and social behavior of scaled quail during the winter period may be used as an aid in determining population trends over a series of years.

Figure 29.--A low growing, bushy shelterbelt of thick-leaved hackberry, Russian mulberry, and Chinese elm, Lloyd Holloway Ranch, August, 1956, 10 miles west of Boise City. This small belt of trees, six rows wide and 80 yards long, was a winter haven for a large covey of scaled and bobwhite quail, pheasants, and rabbits.

Since the same winter homesteads were occupied by a covey of birds each year, systematic covey counts could be made at each of several headquarters sites on adjacent winter homesteads in the three vegetation types after the hunting season from January 15 to March 15. These counts could be made in Cimarron County with the expenditure of only a few man days of effort.

Figure 30.--Elm shelterbelt with pruned trees of negligible value for quail cover, Mizer Farm, five miles west and one mile north of Boise City, March, 1955.

SUMMARY

1. The present investigation was undertaken to ascertain scaled quail habitat-use and spatial behavior and the significance of these to population behavior and level.
2. Field studies were conducted continually from June, 1954, to September, 1955, and intermittently thereafter until January, 1957, in Cimarron County, Oklahoma.
3. One thousand, one hundred and sixty-seven scaled and 46 bobwhite quail were trapped, leg banded, color-marked, and released for further study during 1954 to 1956.
4. Plants of the shrub life-form as well as cultural features provided overhead shelter. Together these two situations totaled 83 percent of 2,048 scaled quail flush observations.
5. The four main nesting situations for 33 of 50 scaled quail nests were dead Russian thistle, implements and junk, mixed forbs, and soapweed.
6. The analysis of 801 scaled quail crops from three vegetation types showed that pigweed, Russian thistle, maize, kaffir, sunflower, gumweed,

few-flowered psoralea, croton, sand lily, and insects were 10 important early winter foods.

7. A larger variety of plant and insect foods were consumed by scaled quail in the pinyon-juniper type than in the other two vegetation types sampled.

8. Eleven of 20 leading early winter scaled quail foods were annual and perennial forbs. The other nine foods included two agricultural grains, two kinds of insects, two grass seeds, a legume seed, a shrub fruit, and herbaceous material.

9. Insect material composed 8 percent of the total food intake in 1954-1955 as compared with only 0.8 percent in 1955-1956.

10. The diversity of foods used by scaled quail suggested that this bird was adapted to feeding on a wide variety of foods.

11. Scaled quail were found, on an average, nearer a water source than would be expected from a randomly distributed population. Thirty-five watering areas were found on four study areas totaling 15,040 acres, or one watering area per 430 acres.

12. Studies were made of the movements of color-marked scaled quail on their winter homesteads. The average area of 10 winter homesteads, 1954-1955, was 52.3 acres with extremes from 24 to 84 acres.

Four of these homesteads were restudied in 1955-1956. These homesteads were essentially the same size for the two winters. Several instances of interchange of quail between established winter coveys were observed.

13. The extremes of movements of the color-marked quail from each of three winter coveys were determined. These movements indicated the approximate boundaries of summer homesteads which ranged in area from 720 to 2,180 acres and averaged 1,370 acres.

14. Shrub vegetation and cultural features were two habitat niches regarded as essential components of the scaled quail regional habitat.

15. The classification of niches in a physiognomic sense is here suggested as a suitable approach to habitat delineation.

16. The importance of the homestead concept was discussed in relation to species survival, carrying capacity, and population regulation. The homestead was suggested as a basic unit for establishing a habitat improvement program.

17. Population density often has been computed by including used as well as unused area. The value of expressing scaled quail density per unit of occupied homestead was discussed.

18. Cover maintenance and development was stressed as an important management tool. Existing cover can be maintained and additional cover encouraged by fencing waste and eroded areas. The planting of drought resistant trees and shrubs, especially pinyon pine, Russian olive, sand plum, skunkbush, and tree cactus was suggested. Top pruning of tree plantings was urged to promote a bushy growth-form. Additional cultural features such as brush piles, platforms, post, board, and junk piles might be placed in blowouts, gullies, and fence corners.
19. Scaled quail population trends in Cimarron County might be sampled by making systematic counts of quail in winter coveys on several adjacent winter homesteads in the three main vegetation types.

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APPENDIX

APPENDIX

A List of Plant Names[1] Used in This Report

Common Name	Scientific Name
Alfalfa	*Medicago sativa* L.
Annual Astragalus	*Astragalus nuttallianus* DC.
Annual Eriogonum	*Eriogonum annuum* Nutt.
Apple	*Malus* sp.
Barley	*Hordeum vulgare* L.
Bee Flower	*Cleome serrulata* Pursh.
Big Bluestem	*Andropogon gerardi* Vitman.
Big Sandgrass	*Calamovilfa gigantea* (Nutt.) Scrib. and Merr.
Bindweed	*Convolvulus* spp.
Black Grama Grass	*Bouteloua eriopoda* (Torr.) Torr.
Bladder Pod	*Lesquerella ovalifolia* Rydb.
Blazing Star	*Liatris punctata* (Hook.) Kuntze
Blue Grama Grass	*Bouteloua gracilis* (H.B.K.) Lag.
Bluegrass	*Poa* sp.
Breadroot	*Psoralea hypogea* Nutt.

[1]The scientific nomenclature of most of the forbs is that given by Stemen and Myers (1937) and Rydberg (1922). Cultivated plant names follow Bailey (1949). Grass names conform to Hitchcock (1950).

Common Name	Scientific Name
Breweria	Breweria pickeringii A. Gray
Brickellbush	Brickellia sp.
Broad-leaved Milkweed	Asclepias latifolia (Torr.) Raf.
Broom Corn	Sorghum vulgare Pers.
Broomweed	Gutierrezia sarothrae (Pursh.) Britt. and Rusby.
Buffalo Bur	Solanum rostratum Dunal.
Buffalo Grass	Buchloe dactyloides (Nutt.) Engelm.
Bug-Seed	Corispermum sp.
Bumelia	Bumelia sp.
Bundleflower	Desmanthus spp.
Bursage	Franseria tenuifolia Harv. and Gray
Bush Morning-Glory	Ipomoea leptophylla Torr.
Caltrop	Kallstroemia intermedia Rydb.
Carpetweed	Mollugo verticillata L.
Catclaw	Mimosa borealis A. Gray
Chamaesaracha	Chamaesaracha sp.
Chaste-Tree	Vitex agnus-castus L.
Chinese Elm	Ulmus parvifolia Jacq.
Clammy-Weed	Polanisia trachysperma T. and G.
Corn	Zea mays L.
Cottontop Grass	Trichachne californica (Benth.)
Croton	Croton spp.

Common Name	Scientific Name
Cryptantha	*Cryptantha* sp.
Dayflower	*Commelina* sp.
Desert Willow	*Chilopsis linearis* (Cav.) Sweet
Dock	*Rumex* sp.
Dodder	*Cuscuta* sp.
Eriogonum	*Eriogonum* sp.
Evening Primrose	*Oenothera* spp.
False Boneset	*Kuhnia eupatoriodes* L.
False Buffalo Grass	*Munroa squarrosa* (Nutt.) Torr.
False Mallow	*Malvastrum coccineum* (Pursh.) A.
Fendler Spurge	*Euphorbia fendleri* (T. and G.)
Fescue	*Festucca* spp.
Fetid Marigold	*Dyssodia papposa* (Vent.) Hitchc.
Few-Flowered Psoralea	*Psoralea tenuiflora* Pursh.
Fortune Fontanesia	*Fontanesia fortunei* Carr.
Foxtail Grass	*Setaria* spp.
Galleta Grass	*Hilaria jamesii* (Torr.) Benth.
Goathead	*Tribulus terrestris* L.
Golden Aster	*Chrysopsis berlandieri* Greene
Grama Grass	*Bouteloua* spp.
Ground Cherry	*Physalis* spp.
Gumweed	*Grindelia squarrosa* (Pursh.) Dunal.
Hairy Grama Grass	*Bouteloua hirsuta* Lag.

Common Name	Scientific Name
Heliotrope	Heliotropium convolvulaceum (Nutt.) A. Gray
Heterotheca	Heterotheca subaxillaris (Lam.) Britt. and Rusby
Hoffmanseggia	Hoffmanseggia sp.
Honey Locust	Gleditsia triacanthos L.
Horse Nettle	Solanum carolinense L.
Illinois Bundleflower	Desmanthus illinoensis (Michx.) Kuntze
Indian Grass	Sorghastrum nutans (L.) Nash.
James Bundleflower	Desmanthus jamesii (T. and G.)
Jimson Weed	Datura stramonium L.
Johnson Grass	Sorghum halepense L. Pers.
Juniper	Juniperus spp.
Kaffir	Sorghum vulgare Pers.
Kashgar Tamarix	Tamarix hispida Willd.
Knotweed	Polygonum spp.
Kochia	Kochia scoparia (L.) Roth.
Lace Cactus	Echinocereus spp.
Lance Leaf Sage	Salvia lanceolata Willd.
Lead Plant	Amorpha spp.
Little Bluestem Grass	Andropogon scoparius Michx.
Lomatium	Lomatium sp.
Lovegrass	Eragrostis spp.
Lupine	Lupinus sp.
Maize	Sorghum vulgare Pers.
Marsh Elder	Iva xanthifolia Nutt.

Common Name	Scientific Name
Mesquite	Prosopis glandulosa Torr.
Milkweed	Asclepias spp.
Millet	Panicum miliaceum L.
Mint	Monarda sp.
Morning-Glory	Ipomoea spp.
Mountain Mahogany	Cercocarpus montanus Raf.
Needle and Thread Grass	Stipa comata Trin. and Rupr.
New Mexican Forestiera	Forestiera neomexicana A. Gray
New Mexico Locust	Robinia neomexicana A. Gray
Oak	Quercus gambellii Nutt.
Oats	Avena sativa L.
Orchard Grass	Dactylis glomerata L.
Osage Orange	Maclura pomifera (Raf.) C. K. Schneid.
Panic Grass	Panicum spp.
Pepperwort Fern	Marsilea spp.
Pigweed	Amaranthus spp.
Pinyon Pine	Pinus edulis Engelm.
Plains bristlegrass	Setaria macrostachya H.B.K.
Ponderosa Pine	Pinus ponderosa Dougl.
Prairie Clover	Petalostemum spp.
Prairie Dropseed	Sporobolus heterolepis (A. Gray) A. Gray
Prairie Zinnia	Zinnia grandiflora Nutt. Kuntze
Prickly Pear	Opuntia spp.
Prickly Poppy	Argemone sp.

Common Name	Scientific Name
Puccoon	Lithospermum linearifolium Goldie
Purple Cactus	Mamillaria vivipara (Nutt.) Haw.
Purple Prairie Clover	Petalostemum purpureum (Vent.) Rydg.
Purple Three-Awn Grass	Aristida purpurea Nutt.
Purslane	Portulacca spp.
Rabbit Brush	Chrysothamnus nauseosus (Pursh.)
Red Three-Awn Grass	Aristida longiseta Steud.
Reverchon's Milk Vetch	Astragalus reverchonii A. Gray
Riddell's Groundsel	Senecio riddellii T. and G.
Ringgrass	Muhlenbergia torreyi (Kunth.)
Rough Tridens	Tridens elongatus (Buckl.) Nash.
Russian Mulberry	Morus alba var. tatarica Loud.
Russian Olive	Eleagnus angustifolia L.
Russian Thistle	Salsola pestifer A. Nelson
Rye	Secale cereale L.
Salt-Bush	Atriplex canescens (Pursh.) James
Sand Bluestem	Andropogon hallii Hack.
Sandbur	Cenchrus pauciflorus Benth.
Sand Cherry	Prunus tomentosa Thumb.
Sand Dropseed	Sporobolus cryptandrus (Torr.) A. Gray
Sand Lily	Mentzelia stricta (Osterhout) Greene

Common Name	Scientific Name
Sand Lovegrass	Eragrostis trichodes (Nutt.) Wood.
Sand Paspalum	Paspalum stramineum Nash.
Sand Plum	Prunus watsonii Sarg.
Sand Sagebrush	Artemisia filifolia Torr.
Sedge	Carex sp.
Siberian Elm	Ulmus pumila L.
Side-oats Grama	Bouteloua curtipendula (Michx.)
Silver Beardgrass	Andropogon saccharoides Swartz
Silver Evolvulus	Evolvulus pilosus Nutt.
Skunkbush	Rhus trilobata Nutt.
Snow-On-The-Moutain	Euphorbia marginata Pursh.
Soapweed	Yucca glauca Nutt.
Sorghum	Sorghum vulgare Pers.
Spurge	Euphorbia sp.
Stickseed	Lappula sp.
Stonewort	Chara sp.
Sudan Grass	Sorghum sudanese (Piper) Stapf.
Sunflower	Helianthus spp.
Sweet Clover	Melilotus spp.
Switchgrass	Panicum virgatum L.
Tansy Aster	Aster tanacetifolius H.B.K.
Texas Croton	Croton texensis (Klotzsch) Muell. Arg.
Thick-leaved Hackberry	Celtis reticulata Torr.

Common Name	Scientific Name
Thistle	Cirsium spp.
Tooth-Leaved Primrose	Oenothera serrulata Nutt.
Tooth Spurge	Euphorbia dentata (Michx.) Small.
Tragia	Tragia nepetaefolia Cav.
Tree Cactus	Opuntia imbricata (Haw.) DC.
Umbrella-Wort	Allionia incarnata (L.) Cockerell
Verbena	Verbena bracteosa Michx.
Verbesina	Verbesina enceliodes (Cav.) B. and H.
Wavy-Leaved Thistle	Cirsium undulatum (Nutt.) Spring
Western Ragweed	Ambrosia psilostachya DC.
Western Wheatgrass	Agropyron smithii Rydb.
Wheat	Triticum aestivum L.
White Juniper	Juniperus monosperma Sarg.
Wild Bean	Strophostyles pauciflora (Benth.) S. Watts
Wild Currant	Ribes odoratum Wendl.
Wild Flax	Linum sp.
Wild Grape	Vitis sp.
Wild Gourd	Cucurbita foetidissima (H.B.K.) Britton
Wild Onion	Allium sp.
Winterberry Euonymus	Euonymus bungeanus Maxim.
Wooly White	Hymenopappus sp.
Yucca	Yucca sp.

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