EVALUATION OF PAYNE COUNTY, OKLAHOMA FARM LANDS AND VEGETATION PATTERNS FOR BOBWHITE QUAIL

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INTRODUCTION

The bobwhite quail, the most popular gamebird in Oklahoma, is a friend of the farmer and nature lover and is a challenge to the sportsman. These represent groups that are continually interested in its welfare, but strange as it may seem they have left its status very largely in the hands of fate.

The rise and fall of the bobwhite population in Oklahoma have been correlated with the agricultural practices, as shown by Duck and Fletcher (1944) and locally by Baumgartner (1944). Despite this knowledge of the importance of land use to quail practically no effective attempt has been made to encourage the farmer to include quail in his land use system. Furthermore, even when the farmer is interested in increasing quail he often fails to accomplish his aim, because he does not know the basic habitat requirements.

The present paper considers some of the detailed relations of bobwhites to "edges" of various types of vegetation. It also gives particular attention to patterns of vegetation apparently most favored by quail. In addition to these points some novel observations and findings regarding quail nesting and population on a relatively small area under intensive study are here placed on record.

Ten 160 acre farms and fifteen covey territories in Payne County, Oklahoma were kept under observation at intervals from August 1, 1948 to August 1, 1949. This study was the first of a five year habitat improvement evaluation study being carried on by the Oklahoma Cooperative Wildlife Research Unit in cooperation with the Pittman-Robertson habitat improvement program of the Oklahoma Game and Fish Department.

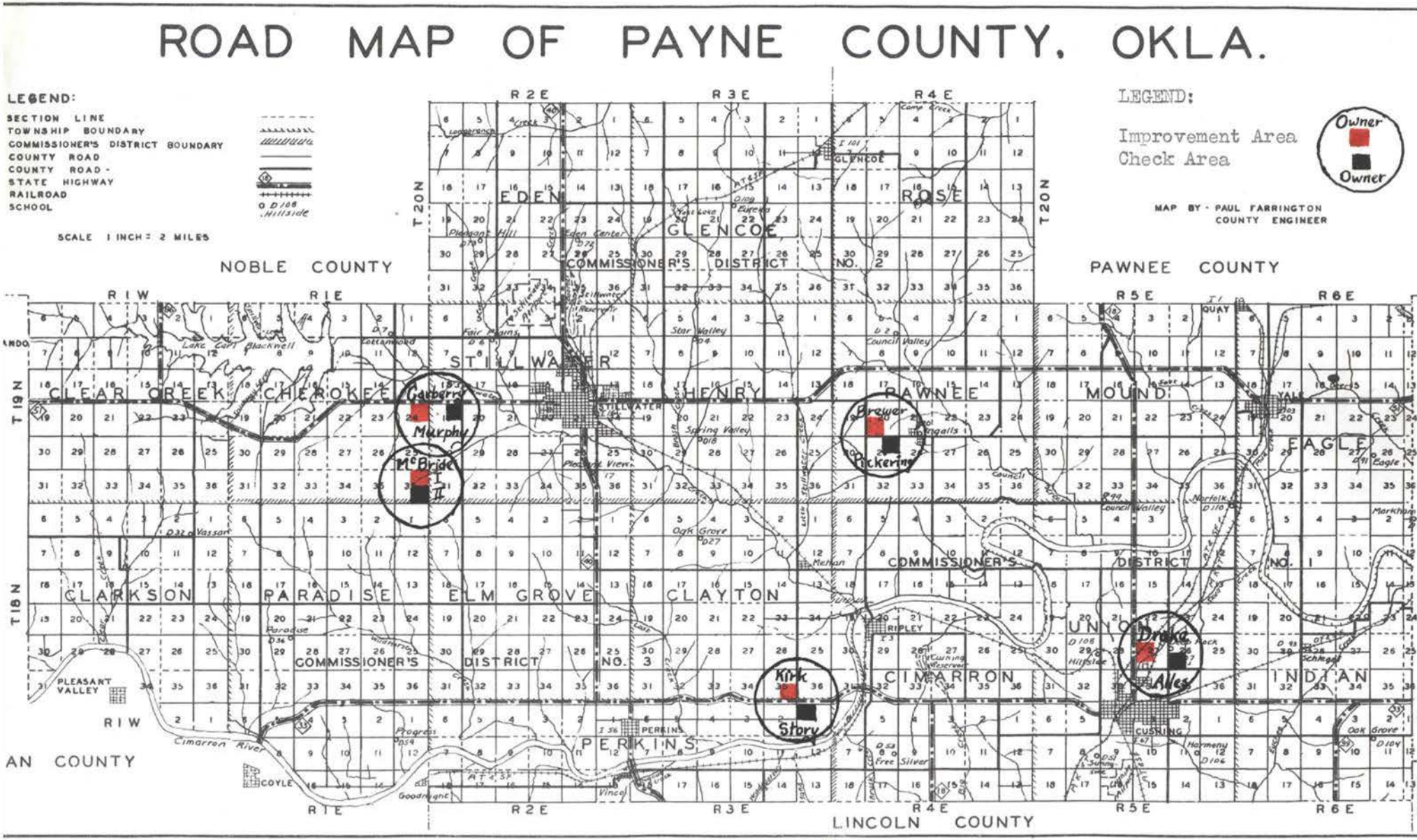

Fig. 1. Distribution of five quail habitat improvement areas and their check areas

METHODS

Selecting Study Areas

Twenty-four improvement areas in Payne County were available for this study, as a result of the Pittman-Robertson habitat improvement program being carried on by the Oklahoma Game and Fish Commission. The owners of these lands had signed a five-year agreement with the Game Commission involving habitat improvements.

The areas were distributed fairly evenly throughout the county in the Post Oak-Blackjack and Tallgrass Prairie game types. Unfortunately none was located in the Bottomland game type which is the third of the three principal game types in Payne County (Duck and Fletcher, 1944).

Five of the twenty-four improvement areas, most nearly representing the typical areas, were selected for intensified evaluation studies of quail habitat improvements. Five additional, but unimproved, areas were chosen as checks against the five improvement areas (Fig. 1). The selection of each check area was based on its similarity in natural vegetation, land use practices, topography and proximity to the improvement area (Table 1). The ten areas together have been frequently referred to at intervals in this manuscript as the study areas.

Establishment of the Range or Territory

Fifteen winter covey territories were located by using the following census methods: flushing quail by using a close working bird dog or by accidentally walking into them; hearing the covey whistle during the day or as they came off the roost in the morning; locating sign: finding roosts, droppings, dusting

sites, and tracks in the snow or soft mud; analyzing the crop and stomach contents; and collecting flush reports from farmers, sportsmen, and other interested persons.

Information on each individual or group of quail flushed was daily carefully recorded in the field, first by spotting the actual flush on a field map, and second by extensive record of all details on a specially prepared flush sheet. (See appendix). The territories were defined on transparent overlays by including all locations where quail evidence was found. In bounding the territories, the practice was used of including a strip of indefinite width, depending on the lay of the land, extending outside of the area where quail were known to be, so as to include probable places utilized by each covey.

TABLE 1

LOCATION AND OWNERSHIP OF FIVE QUAIL HABITAT IMPROVEMENT AREAS AND FIVE CHECK AREAS IN RELATION TO VEGETATION TYPES IN PAYNE COUNTY, OKLAHOMA

Improvement Area			Control or Check Area		
Owner	Legal Description	Acreage	Owner	Legal Description	Acreage
Post Oak-Blackjack					
C. R. Carberry	NW¼S24-19-1E	160	W. B. Murphy	NE¼S25-19-2E	160
Willis McBride I	NE¼S36-19-1E	160	Willis McBride II	SE¼S36-19-1E	160
Lee Kirk	SE¼S35-18-3E	160	Josephine Story	NW¼S1-17-3E	160
Tallgrass Prairie					
W. A. Drake	S½NW¼ and N½ SW¼S27-18-5E	160	Elizabeth Alles	SW¼S26-18-5E	160
Virgil Brewer	SW¼S20-19-4E	160	Roy Pickering	NE¼S29-19-4E	160

Classification of Sub-types of Vegetation

In order to determine the habitat requirements of bobwhites the vegetation on the study areas was arbitrarily classified into nine sub-types as follows: (1) Oak Woodland, (2) Timbered Ravine, (3) Hedges and Thickets, (4) Grazed Tallgrass, (5) Ungrazed Tallgrass, (6) Grazed Shortgrass, (7) Ungrazed Shortgrass, (8) Forbs, and (9) Cultivation. A brief description of each sub-type, giving some of the dominant plants in each, is given below.

1. Oak Woodland - This sub-type consists of woodlands dominated by post oak (Quercus stellata) and blackjack (Quercus marilandica). (Fig. 2).
2. Timbered Ravine - Any seepage area or creek bottom grown up to trees and revealing one or more of the following tree species was included in this sub-type: Elm (Ulmus americana), hackberry (Celtis spp.), cottonwood (Populus deltoides), buckthorn (Bumelia lanuginosa), willow (Salix spp.), and coffee tree (Gymnocladus dioicus). (Fig. 3).
3. Hedges and Thickets - Consists of woody vegetation along fencerows, field borders, roadsides, and in upland fields. It is represented by the rough leaf dogwood (Cornus drummondii), Chickasaw plum (Prunus angustifolia), redbud (Cercis canadensis), persimmon (Diospyros virginiana), sumac (Rhus spp.), blackberry (Rubus spp.), and coralberry (Symphoricarpos spp.). (Fig. 4).
4. Grazed Tallgrass - Includes steadily grazed pastures having over 50 percent of their vegetation in tallgrass. This sub-type is dominated by the bluestems (Andropogon spp.), Indian grass (Sorghastrum nutans), purpletop (Triodia flava), and switchgrass (Panicum virgatum). (Fig. 5).

Fig. 2. Oak Woodland Sub-type, Carberry Farm

Fig. 3. Timbered Ravine Sub-type with Ungrazed Tallgrass Sub-type in foreground, Hardy Farm adjoining Carberry Farm.

Fig. 4. Hedges and Thickets Sub-type, hat shows site of bobwhite quail nest in Ungrazed Tallgrass Sub-type, Carberry Farm.

Fig. 5. Grazed Tallgrass Sub-type with Timbered Ravine Sub-type in background, Carberry Farm.

5. Ungrazed Tallgrass - This includes all tallgrass meadows that are ungrazed. The plant species are the same as grazed tallgrass, except for the cultivated species like the weeping lovegrass (Eragrostis curvula) and other species used for seed and hay. (Fig. 6).
6. Grazed Shortgrass - All pastured shortgrasses, annuals or perennials, whether true shortgrass or not, were put into this category. An area having over 50 percent coverage of any or all of the following was placed in this group. The three-awn (Aristida spp.), Bermuda grass (Cynodon dactylon), bluegrass (Poa annua), buffalo grass (Buchloe dactyloides), and grama grasses (Bouteloua spp.). (Fig. 7).
7. Ungrazed Shortgrass - Similar to grazed shortgrass, except there is no grazing. (Fig. 8).
8. Forbs - The so-called weeds or non-graminaceous herbs belong here. Korean lespedeza (Lespedeza stipulacea) was put in this category because it was not sufficiently common on the study areas to be placed in a separate group. The species important to bobwhite making up this type are sunflower (Helianthus spp.), ragweed (Ambrosia spp.), golden-weed (Aplopappus ciliatus), lambs-quarters (Chenopodium spp.), pigweed (Amaranthus spp.), snow-on-the-mountain (Euphorbia marginata), trailing wild bean (Strophostyles spp.), and partridge pea (Cassia chamaecrista). (Fig. 9).
9. Cultivation - In this category were placed disturbed areas, bare ground, roads and areas about buildings, and all domestic species of plants under cultivation, other than those used for hay or meadow crops. For the most part the cultivated plants were sorghums, corn, wheat, and cotton as well as soil builders such as hairy vetch. (Fig. 10).

Fig. 6. Ungrazed Tallgrass Sub-type, Hardy Farm adjoining Carberry Farm.

Fig. 7. Grazed Shortgrass Sub-type with Timbered Ravine Sub-type in background, Carberry Farm.

Fig. 8. Ungrazed Shortgrass Sub-type with Ungrazed Tallgrass Sub-type in background, Hardy Farm adjoining Carberry Farm.

Fig. 9. Forbs Sub-type with Timbered Ravine Sub-type in background, near Lake Carl Blackwell.

Fig. 10. Cultivation Sub-type with Timbered Ravine Sub-type in background, Carberry Farm.

Measurement of Sub-types of Vegetation

In order to determine the amount in acres of each vegetation sub-type in the fifteen territories and in the ten study areas, a small grid measuring device showing one acre marked off into tenth acre units was used. This is a faster and easier device than the planimeter and apparently gives just as accurate results. All measurements were taken from enlargements (12.5 inches per mile) made from Soil Conservation Service aerial photographs (8.5 inches per mile) taken in 1938.

The linear measurement of the amount of edge of each vegetation sub-type, in all the areas, was taken with a cartometer which measured in inches. One inch on the cartometer represented 140.8 yards on the aerial photo. In determining the amount of edge of each vegetation sub-type on an area, each edge was measured twice - once for each of the adjoining types. This measurement while truly representing each vegetation sub-type had to be cut in half when used for the total amount of edge in the area.

Flushes in Relation to Edge

Flushes were classified as being 0 to 5 yards, 5 to 25 yards and 25 to 50 yards away from the edge.

Yards of Edge Per Acre

This number was determined for each covey territory or covey site by totaling the number of yards of edge, dividing it in half, and then dividing it by the total number of acres. The yards of edge per acre was obtained for all the areas - the fifteen covey territories and the ten study sites.

In determining the vegetation sub-type requirements for quail each sub-type was ranked according to the number of yards of edge per acre. This ranking was compared with the ranking given to the vegetation sub-type by using the number of flushes per sub-type.

DESCRIPTION OF TEN STUDY AREAS AND THEIR COVEY TERRITORIES

In order to understand the relationship between the condition and pattern of vegetation and the distribution of quail, each study area and its quail territories are described below.

C. R. Carberry Farm (NW¼ of S24-T19N-R1E)

Description of Area (See map 1, appendix)

This 160 acre upland improvement area, located four miles west of Stillwater on State Highway No. 51, had a gently rolling topography with a slope not greater than six percent. This area is being rejuvenated by modern Soil Conservation Service practices.

The Soil Conservation Service's land capability (see Soil Conservation Service, 1948) found on this area were as follows: 90 acres of Class VII, 60 acres of Class III, and 15 acres of Class I land. The amount of land covered by different land use practices was: 50 percent in pasture, 30 percent in meadow, and 20 percent in cultivation.

The vegetation sub-types having the greatest acreage were grazed tallgrass, ungrazed tallgrass, grazed shortgrass, and cultivation. The greatest edge per acre was exhibited by hedges and thickets, timbered ravine, oak and ungrazed tallgrass.

Five covey territories were located on this farm thus giving it the highest quail population of all the areas. Approximately 80 acres was poor winter quail range. This bare, upland area was located in the western half of the farm. It was used by quail only during the nesting season. Four of the five covey territories were concentrated in the lowland, eastern half of the farm. The other

territory is located in the northwestern corner. A short description and analysis of each territory is given below.

Covey Territory 1

Part of this 59 acre territory was located in the northwestern corner of Carberry's, while the remaining portion was located off the farm to the northwest. This territory was centered around a timbered ravine which ran northwest down a slope and across State Highway No. 51. Practically all of this area consisted of Class VII land; three-quarters of it was pastured and the remainder in meadow. Ungrazed tallgrass, particularly the lovegrass meadow, produced an excellent crop of quail for this territory during the nesting season, but the overwintering carrying capacity was very low. From approximately 20 birds produced in the fall only three remained at the time of spring breakup. Twelve of these birds perished during the critical winter weather of January and February 1949. Overgrazing was responsible for reducing the carrying capacity by unduly opening the understory vegetation in the timbered ravine. Two new parallel terraces located in the west side of the lovegrass meadow had a rank growth of sunflower which attracted quail in the fall of 1948.

Covey Territory 2

This 25 acre territory was situated in a north-south timbered ravine located in the northeast quarter of the farm. The trees in this bottom were girdled with the intention of eliminating them and increasing the cultivated area. The covey territory was peculiar in that a two-acre sweetclover field as well as the timbered ravine with the girdled trees were being used as headquarters. This territory with its Class I land was completely eliminated the following year by clearing this sweetclover field for cultivation. Out of a covey of 10 birds seven were killed during the hunting season and the remaining three succumbed

during the critical period of winter weather in January and February 1949. Possibly this was due to their inability to maintain body temperature at night (Gerstell, 1942, pp. 42-44).

Covey Territory 3

Located in the eastern part of Carberry's northeast quarter and off the farm to the east, this 47 acre territory had a series of gulleys containing sunflowers which were being used as covey headquarters. These gulleys were filled in by a bulldozer in the spring of 1948. Plant succession is eliminating this territory since the sunflowers in the gulley areas are being replaced by less desirable food plants. With the exception of approximately two acres of timbered ravine which was located on Class I land, the area was considered Class VII land.

Of the covey of 12 birds which made its headquarters in the sunflowers of this territory only five birds remained by breakup time in the spring. There were no reports of this covey being hunted.

Covey Territory 4

This 27 acre territory was located in the central part of the north-south timbered ravine. It over-lapped territory 2 on the north and territory 3 on the south. The greater part of this territory, the timbered ravine section, was considered Class I land. Most of the area was lightly grazed in the winter. This was a strong territory, having all the requirements necessary for carrying a covey of quail throughout the winter. Most of it will be eliminated, however, when the timbered ravine is cleared for cultivation.

A large covey of 15 or more birds inhabited this area during the fall. Five birds were known to have been shot during hunting season and seven birds remained at the time of breakup.

Covey Territory 5

This 51 acre territory was located in the southeastern part of Carberry's Farm. It included part of neighboring farms to the south and to the east.

Approximately half of this area was grazed while the other half was ungrazed. There were three timbered ravines in the area. Approximately four acres was considered Class I land while the remainder was considered Class VII. Interspersion of vegetation types was excellent.

The covey started out with 10 birds in the fall and ended up with 11 birds in the spring. The increase was due to an influx of quail during the critical winter weather. One acre of Korean lespedeza growing in a three-awn grass meadow just south of Carberry's southern boundary, was important in bringing this covey through the winter. At that time the covey repeatedly was tracked and flushed in this lespedeza. Signs showed they had been eating seed heads of this plant.

W. B. Murphy Farm (NE¼ of S25-T19N-R2E)

Description of Area (See map 2, appendix)

This check area to the Carberry Farm was located one-half mile to the east on State Highway No. 51. It compared favorably with the improvement area with the following exceptions: there was no oak woodland or grazed tallgrass; only 35 percent was in pasture; and it had twice the number of cattle. Like the improvement area it had a large block of land lacking in woody cover and consequently poor quail range. The total amount of edge per acre was 8¼ yards while that on Carberry's was 91 yards. (See edge relationships). There was less Class I land than on the improvement area.

This check area naturally had a lower quail carrying capacity than did the improvement area because the interspersion of vegetation types was poorer

and a large section of the timbered ravine was open and park-like as a result of severe overgrazing.

A pond and a small timbered ravine isolated by a tallgrass meadow in the southeast quarter of the farm produced quail during both summer seasons, but the broods left the area before November. According to Baumgartner (1948) this area held quail through the winter of 1945-46 and 1946-47. The only really satisfactory quail territory on this farm is next described.

Covey Territory 6

This 52 acre covey range was located in the eastern and northern parts of the Murphy Farm and was centered around several shallow timbered ravines. The covey headquarters was situated in a shallow, ungrazed, east-west timbered ravine in the northern half of the farm. This timbered ravine had an excellent interspersion of forbs; in fact, this territory had the second highest edge per acre ratio of all the territories considered in this study.

A covey of ten birds inhabited this area in the fall. Four birds were known to have been killed during hunting season. There were six birds remaining at breakup time. This excellent carry-over is in line with the high edge per acre ratio of this territory.

Willis McBride Farm I (NE¼ of S36-T19N-R1E)

Description of Area (See map 3, appendix)

This improvement area was located four miles west and two miles south of Stillwater in the post oak-blackjack oak woodland. Sixty-five percent of the land was forested. The trees were broken up by several pastured openings and timbered ravines.

The soil was very shallow and easily eroded; consequently all the land was rated Class VII. Cultivation sites had been abandoned about 12 years ago. During the period of this study overgrazing on these former cultivation sites was responsible for increasing soil erosion. Grazing was the only land use practice in effect. There were, on the farm, no ungrazed tallgrass, ungrazed shortgrass, nor cultivation vegetation sub-types.

Part of a covey territory was located in the southeastern quarter of this area, but since most of it was on the check area it will be described there. Two coveys moved into this improvement area during the critical period of weather in January and February of 1949. They roosted and fed in the deep timbered ravines which gave them protection from the cold. These birds were not found in the area before or after the cold spell.

Willis McBride Farm II (SE¼ of S36-T19N-R1E)

Description of Area (See map 4, appendix)

This check area joined the improvement area on the south. Like the improvement area it had a great amount of oak woodlands, no ungrazed tallgrass, ungrazed shortgrass, or cultivation sub-types, and consisted entirely of Class VII land. The tallgrass pastures were not as heavily grazed on this area as on the improvement area because they were farther from the cattle corral. The interspersion of vegetation sub-types was naturally poorer than the improvement area. This is shown by its lower edge per acre ratio (Fig. 16).

While two coveys were found using this area, only one appeared consistently; as a result only one territory was defined. This territory was located in the northeastern quarter of the area near an old house site. The other

covey was seen in a ditch along a section line road on the east side of the farm. A brood was seen in this same location the following summer.

Covey Territory 7

This 45 acre territory was centered around a grassy opening in the northeastern quarter of the check area and the southeastern quarter of the improvement area. There was an abundance of cover but food was lacking because the mast crop was light and the acorns available were infested with weevils. The covey began with eight birds in the fall and ended up with three birds at breakup time in the spring. Four birds are known to have succumbed during the period of critical weather. The fate of the other individual was not determined.

Virgil Brewer Farm (SW¼ of S20-T19N-R4E)

Description of Area (See map 5, appendix)

This upland farm was located eight miles east and one mile south of Stillwater. While deficient in woody cover, there were a few remnants of timbered ravines and thickets around the eastern and southern boundaries but these were too open and scattered to afford sufficient cover for quail.

Fifty-percent of the area was in pasture, 30 percent in cultivation and 20 percent in meadow. Approximately 50 percent of its lands were Class VII and 50 percent Class III. The vegetation sub-types were in large blocks and poorly interspersed. Indeed Brewer's had the lowest edge per acre ratio of any of the areas (Fig. 16).

The area produced quail in the summer but with the exception of a single covey the birds moved off in the fall to lowlands having good cover. The single covey mentioned stayed in the upland area all winter. Another covey sometimes fed in a sorghum patch which was located on the east central part of the farm.

Covey Territory 8

This 77 acre territory, located in the southwestern portion of Brewer's Farm and overlapping onto adjoining farms on the south and west, was lacking in woody cover. It was the largest single territory among those studied and had the second lowest edge per acre ratio.

The covey headquarters was located around an old house site on the adjoining farm to the north. In order to meet their requirements, the birds were forced to range over an unusually large area. Even then they did not fare too well during the period of extremely cold weather in January and February 1949.

There were 15 birds in the fall but only three remained in the spring at breakup time. Seven birds were shot during hunting season and five succumbed during the critical period of winter weather.

Covey Territories 9 and 10

These were located on Lon Case's Farm east of Brewer's. They are here considered together because in late winter the two coveys combined and used the entire area.

The consolidated territory of 77 acres was poorer than its components, because much more land than the sum of its component territories was included in it. The area was lower than surrounding areas. Some of it was very poor quail land, but as a whole it had more woody vegetation and afforded better shelter for bobwhites than the surrounding uplands, as a result of which the quail moved into it for fall and winter range.

Seventy-five percent of the area was in pasture, 15 percent in hay meadow, and 10 percent in cultivation. The land use capability classes were approximately 85 percent Class VII and 15 percent Class III.

Previous to combining, covey territory 9 had 10 birds, while covey territory 10 had around 20. These two coveys combined as a result of (1) overshooting the covey in territory 9, and (2) the critical winter weather of January and February 1949. Approximately 15 birds remained at breakup time in the spring.

Roy Pickering Farm (NE¼ of S29-T19N-T4E)

Description of Area (See map 6, appendix)

This check area, an upland farm, was located southeast of Brewer's Farm. Like the improvement area it lacked woody cover since clean farming was practiced.

Approximately 50 percent of the farm was Class III land, 40 percent was Class VII land, and 10 percent was Class I land. Forty-six percent of this land was in cultivation, 24 percent in tallgrass meadow, and 29 percent in shortgrass pasture. This farm had the poorest interspersion of vegetation subtypes of any of the study areas.

It was used as nesting grounds by quail. The orchard near the farm buildings was a favorite nesting site. For fall and winter range the covey moved off this area to the lowlands.

Three covey territories touched the boundaries of this farm; one on the north, the consolidated covey formed from coveys 9 and 10, and two on the south. One of these coveys on the southern boundary was discovered in the spring too late to define its territory.

Covey Territory 11

This 61 acre territory was centered around a timbered ravine south of Pickering's southern boundary. It was another catch basin for coveys raised in

the surrounding uplands to the north, south and west. The majority of this territory was pastured; approximately eight percent was cultivated; and about three percent was hay meadow. This territory had a better interspersion of vegetation sub-types than Pickering's or any of the other surrounding areas. It provided a satisfactory quail range during the fall and winter periods.

Lee Kirk Farm (SE¼ of S35-T18N-R3E)

Description of Area (See map 7, appendix)

This improvement area was rendered unsuitable for quail during the winter of 1948-49 as a result of overgrazing by 80 head of cattle, 7 horses and 40 hogs on 146 acres or one animal unit per 1½ acres.[1]

Ten acres were considered Class III land while the remainder was considered Class VII. In addition to the 146 acres in pasture, 10 acres was in cultivation and four acres in buildings and grounds.

The fine sandy loam soil produced an excellent growth of forbs as a result of disturbance by overgrazing during previous winters. The next year these forbs were eliminated by overgrazing.

No coveys used this farm for their winter range. One covey inhabited part of the southwestern pasture during the early fall but later moved west to an adjoining farm and remained there until breakup time in the spring. The records on this covey were too few to establish its territory. Two covey territories, as follows, were located on the farm south of Kirk's.

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[1] An animal unit is 1 cow, horse or mule; or 5 sheep, goats or swine. (Forest Service, U. S., 1936, p. 3).

Covey Territory 12

This 35 acre territory was centered around an excellent fence row thicket that was located south, across State Highway No. 33, from the central part of Kirk's south boundary. This territory had an excellent food supply but lacked a timbered ravine and a good interspersion of sub-types, consequently it failed to sustain its covey during the severe period of winter weather (January and February 1949).

The edge per acre ratio was lower than that of Kirk's Farm but higher than that on Josephine Story's. (See fig. 16, appendix). Of 10 birds in the fall only three remained at breakup time in the spring. The greatest loss occurred during the period of critical weather.

Covey Territory 13

The northern part of this 44 acre territory overlapped part of territory 12. Unlike the previously described territory it had a timbered ravine and a field of Korean lespedeza. It was characterized by a greater edge per acre ratio than Kirk's Farm and carried a covey through the bad weather of January and February 1949.

Approximately 35 percent of the area was ungrazed, 20 percent lightly grazed, and 10 percent overgrazed. There was no cultivation. This area was considered as Class VII land.

A 15 bird covey inhabited this territory in the fall. At the time of the spring breakup, 11 birds remained. Except for one bird which succumbed during the critical period, the loss was not limited to any certain cause or period.

Josephine Story Farm (NW¼ of S1-T17N-R3E)

Description of Area (See map 8, appendix)

This check area, lying just off Kirk's southwestern corner, had 44 acres of grazed oak woodland, 46 acres of shortgrass pasture, and 50 acres of cultivation.

Approximately 40 percent of this land was Class III and the remainder was Class VII. The amount of edge was less than on Kirk's Farm. Like the improvement area this check area had a fine sandy loam which produced an excellent crop of forbs. It also resembled the Kirk Farm in being severely overgrazed.

A covey of 10 birds used as their headquarters a small timbered ravine, located in the southeastern quarter of the farm. However, this covey moved out of the area early in the fall to Howard Carlton's Farm to the west. This movement was correlated with the introduction of a herd of cattle into this section. No territory was described for this covey because it could not be found during the late fall or winter.

W. A. Drake Farm (S½ of NW¼ and N½ of S27-T18N-R5E)

Description of Area (See map 9, appendix)

Civilization is slowly encroaching upon this farm. An oil-tank-farm and refinery were located on its eastern boundary; a housing project and railroad right-of-way in its northwest quarter; houses, a sewage disposal plant and a creek (polluted with oil and sewage) on the south boundary; and houses and a highway on its west boundary. In spite of all this pressure, this area had the next highest production of quail of any of the study areas.

Approximately 50 percent of this farm was pastured to sheep which kept the grass succession in the shortgrass stage and the timbered ravines park-like.

Thirty-five percent was in cultivation, the remainder in meadow or timbered ravines. Approximately 25 percent was considered Class I; 25 percent Class III; and 50 percent Class VII land.

The two covey territories were restricted to the ungrazed, timbered ravine lowlands on the east boundary of the farm.

Covey Territory 14

Most of the 44 acre territory was located in the northeastern part of the farm. The covey headquarters was located around an ungrazed timbered ravine which had an excellent interspersion of forbs and briars.

These birds were limited in their eastward movements by the tank farm; westward by the railroad right-of-way, cultivation, and an overgrazed pasture; and northward by the railroad right-of-way and tank farm.

Approximately 15 birds represented this covey in the fall, but only six remained at spring breakup. The heavy hunting pressure was responsible for this great decrease. Only a few died during the cold weather of January and February 1949.

Covey Territory 15

This territory was centered around a lightly grazed timbered ravine located east of Drake's west boundary. A six acre field of Korean lespedeza sustained the covey during the critical period of winter. The lespedeza field, located south of Drake's southeastern corner, attracted the birds despite its lack of suitable cover. They fed here from February 1949 until the spring breakup.

This covey had approximately 15 birds in the early winter and ended up with the same number in the spring.

Elizabeth Alles Farm (SW¼ of 26-T18N-R5E)

Description of Area (See map 10, appendix)

This check area had a smaller amount of edge than Drake's Farm. Three quarters of the Alles Farm was overgrazed and shortgrass predominated. Fifteen percent was in tallgrass meadow and the remaining ten percent in cultivation. Ninety percent of the area was considered Class VII, the remaining ten percent Class III.

The farm was too open to be most favorable for quail and lacked a thick undergrowth of woody cover. The covey left the area in the fall for a better quail range to the northwest.

EDGE RELATIONSHIPS

Review of Literature

Edge as used in this study refers to the boundary between dissimilar vegetation sub-types, as for example "timbered ravine" and "cultivation." This boundary may or may not exhibit width, depending upon the nature of the adjoining sub-types.

Leopold (1933, pp. 131-132) was one of the first proponents of the edge concept and its importance to quail and other game. He stated that "game is a phenomenon of edges," and that "edge effects are most numerous in game of low mobility and high type requirements." Further, that "the linear mileage of type edges available in any block of range is, as a matter of geometry, proportional to the degree of interspersion." Finally, he proposed the following law of dispersion: "The potential density of game of low radius requiring two or more types is, within ordinary limits, proportional to the sum of the type peripheries." Interestingly enough, since this law was proposed there have been few recorded observations in support of it.

A few studies have been made showing the importance of edge to game birds. Sumner (1935, pp. 281-285) found that the California quail is a bird of the edges. Edminster (1947, p. 61) acknowledged the lack of edges as a major factor in keeping down the ruffed grouse carrying capacity. Bump, Darrow, Edminster and Crissey (1947, pp. 170-176) found that there was no tendency for ruffed grouse to be found along cover type edges. However, they did find that, in general, the larger number of edges, the higher the average grouse population the area supported. Nevertheless, in their summary of grouse edge relationships, they minimized the importance of edge to grouse cover productivity. Lehmann (1937, pp. 11-12), although presenting no data in support of his statements,

recognized bobwhite to be a bird of the edges. Previous to Leopold's proposal of the edge concept, Stoddard (1931, p. 21), found that bobwhite nests were associated with openings or edges. This nest-edge relationship study by Stoddard has been the only confirmation found by the writer in literature based on recorded field observations, that the bobwhite is a product of the edge. The purpose of the phase of the present study now to be considered was to determine the relationship between the bobwhite quail and vegetation-type edges.

Flushes in Relation to Edge

In order to determine the importance of edge to the bobwhite an attempt was made to correlate the nearness of flushes to the edge. The results of 204 flushes of 19 coveys showed that 62 percent were made within five yards of the edge, 37 percent from 5 to 25 yards from the edge, and only a fraction of one percent was made over 25 yards from the edge. Seemingly this evidence, so far as it goes, indicated that the bobwhite quail is a bird of the edges.

Edge Per Acre - Indicator of Quail Territory

If quail is a bird of the edge, the amount of edge on any given area should reflect the potential numbers of quail per area as suggested by the law of dispersion. To determine whether or not this was true the amount of edge per acre for each territory was compared with that of the nearest study area. (See fig. 16, appendix). Then the average edge per acre of 15 territories was compared with the average edge per acre of the 10 study areas.

Fourteen of the 15 territories had a much higher edge per acre ratio than their study areas. Territory 12 had a slightly lower edge per acre ratio (54

to 59 yards) than the nearby improvement area but it was higher (54 to 47 yards) than that of the nearby check area.

The average edge per acre of all the territories was 97 yards, while that of the study areas was 60 yards. (See table 3, appendix). So far, at least the present findings support Leopold's law of dispersion.

Edge and the Sub-types of Vegetation

Quail were found to be associated with some sub-types more frequently than with others (Fig. 15, appendix). The linear amount of edge afforded by each sub-type was measured in order to determine whether or not there was any correlation between edge and the number of flushes. (See fig. 15 and table 3, appendix).

Seven of the nine sub-types showed a correlation. Timbered ravine was first in the number of flushes and second in the amount of edge; hedges and thickets was second in flushes and first in the amount of edge; forbs was third in the number of flushes and fourth in the amount of edge; ungrazed tallgrass was fourth in the number of flushes and fifth in the amount of edge; grazed shortgrass was sixth in the number of flushes and seventh in the amount of edge; ungrazed shortgrass was seventh in the number of flushes and sixth in the amount of edge; and grazed tallgrass was ninth in the number of flushes and eighth in the amount of edge. Oak woodland and cultivation did not show any correlation. Oak woodland was fifth in the number of flushes and ninth in the amount of edge; and cultivation was eighth in the number of flushes and third in the amount of edge. The lack of correlation in oak woodland and cultivation can be explained as follows: Oak woodland exhibits a great amount of edge within

its borders that could not be measured by the methods used in this study, and cultivation showed a higher amount of edge than it ordinarily would because all bare and disturbed areas, such as highways, were included in this category.

THE BASIC SUB-TYPES AND PATTERNS OF VEGETATION

From the standpoint of management it is essential to know what sub-types are basically important for quail. It is likewise valuable to know the minimum size of the territory and its relationship to the pattern of the sub-types.

The basic pattern of vegetation was determined by (1) the number of flushes in each sub-type, (2) the amount of edge afforded by each sub-type, (3) the amount of edge per acre afforded by each territory, (4) the relative percentages of sub-types in the territories compared with those of the study areas (Fig. 14, appendix), and (5) a general knowledge of the area.

The Basic Sub-types of Vegetation

The most important sub-types of vegetation for bobwhites were: timbered ravine, hedges and thickets, forbs, and ungrazed tallgrass.

Timbered ravine was the most important vegetation sub-type for quail. The following factors are believed to be responsible for its importance: it has a great amount of edge per acre; it is associated with sheltering banks and protective vegetation thus affording potential shelter to the birds in time of storm and it has a large variety of plants, many of which are suitable foods for quail.

Hedges and thickets were important because they provided food, cover, and travel lanes in the upland areas where these requirements are usually scarce. This sub-type had the greatest amount of edge, but was second to the timbered ravine in the number of flushes. Being situated in the upland exposed areas it offered less protection from the cold winter winds than did the timbered ravines. As an example covey territory 12 had an excellent thicket, but no timbered

ravine. As a result it failed to adequately support its covey which dwindled from ten to three birds during the below zero weather of January and February of 1949.

Forbs are primarily the food producing sub-type. Forbs ranked third in importance in the number of flushes and fourth in the amount of edge per acre. The presence or absence of this sub-type usually determines the quality of a territory. For example territories 2, 3, and 4 were eliminated when their large acreages of forbs were removed by cultivation and natural succession of vegetation.

Ungrazed tallgrass followed forbs in importance. Quail used this sub-type for roosting, nesting, and occasionally for feeding. Its value depended upon the species of grasses and associated weeds and their density. For instance, native prairie meadows were best when of medium density. Johnson grass is best when very dense. Weeping lovegrass, although very important for nesting and for broods, was not important for coveys.

Maximum quail production can be obtained if the above four sub-types (timbered ravine, hedges and thickets, forbs, and ungrazed tallgrass) are present. The other five vegetation sub-types can be lacking without altering this production. However, on many of the study areas one or more of the top four principal sub-types were absent and the lesser sub-types replaced them without greatly altering the quail production. Oak woodland with its mast production can supplement territories that are short on timbered ravines and forbs; while medium to lightly grazed tallgrass can replace or supplement ungrazed tallgrass; and cultivation, depending on the crop grown, can replace or supplement forbs if left standing near cover.

Territory Size and Pattern Requirements

It was previously pointed out that within a territory some sub-types are more important than others. The question then arises regarding the minimum size of the territory and the best pattern or arrangement of sub-types within the territory for the maximum production of game.

Territories 2 and 4, each 25 acres in size, were excellent quail ranges. In contrast, territory 8, consisting of 77 acres, was found inadequate during a critical period of weather. In comparing these territories it was found that the small ones had a high edge per acre ratio (130 and 145 yards per acre respectively) thus indicating a good pattern of sub-types; whereas the large territory had one of the lowest edge per acre ratios (59 yards per acre) found in the study, which indicated a poor pattern of sub-types. As a consequence, in the larger territories quail must travel greater distances to meet their requirements if they can reach them at all. Forty-nine acres with 97 yards of edge per acre were the averages of all territories.

From the point of view of management it is important to know that relatively small territories can have a high carrying capacity if the essential sub-types are present and properly arranged.

VARIATIONS IN THE SUB-TYPE QUALITY AS AFFECTED BY LAND USE PRACTICES

Areas having similar vegetation patterns can differ widely in their quail carrying capacity. These differences are due to the quality of the vegetation within each sub-type, as affected by land use practices. These land use practices were clean cultivation, grazing, soil conservation, hay cropping, and burning. The following description of these practices illustrates the variation which does occur and explains their relationships to quail requirements.

Clean cultivation over large areas is not good for quail because of the consequent lack of woody cover. If the boundaries are allowed to grow up to thickets or hedges the area becomes available to quail. The desirability of cultivation for quail depends upon the crop grown and the method of harvesting - Sorghums and corn are more important than cotton; however, these favorable grains are still better when left standing near field borders. Cultivation practices, which decrease the soil fertility over a long period of time, will indirectly affect the quail carrying capacity.

Grazing by cattle, sheep, horses, and hogs impairs the quality of the range vegetation. Overgrazing eliminates good ground cover and opens the territory to erosion. When this happens quail must expand their range in order to meet their needs.

Hay cropping native tallgrass meadows eliminated these areas for quail nesting and roosting. After cutting, the meadows were barren, not only of growing stems but accumulations of the old dry material necessary for good roosting cover. Previous to cutting they were usually too dense for nesting. On the other hand the exotic weeping lovegrass was an excellent nesting and brooding area. The drilled rows make excellent runways for quail.

Burning native prairie meadows in the spring eliminated these areas for quail nesting.

Soil conservation practices are designed to save and improve the fertility of the soil. Ordinarily one would think that these practices would benefit quail, for almost inevitably they increase soil fertility and build up the productivity of the vegetation. However, when the Soil Conservation Service's practices lead to the destruction of quail territories as in territories 2, 3, and 4 (pp. 15 and 16, this manuscript), by clearing ravines of protective and often productive vegetation, by cutting out hedges, thickets, and weed patches, they are definitely detrimental to good quail production. Undoubtedly some results of this kind are inevitable as lands are made into more and more productive units for farm crops.

The land use capability soil classes (I to VIII) were developed by the Soil Conservation Service in an attempt to insure more adequate planning for increased farm production. Relegation of wildlife production to Class VIII land (so poor it cannot be used for anything else) is in the highest degree misleading and unfortunate. For bobwhite quail, and indeed wildlife in general, is a crop, and as such, will do best on the most fertile soil. If quail and other wildlife are produced, they must be produced on lands of Classes I to VII.

Seemingly quail management, at least up to a certain point, can be incorporated with soil conservation practices without interfering with other crop raising by allowing fencerow borders to grow up into thickets; planting living fences and other multipurpose plants along field borders; fencing woodlands and timbered ravines; and fencing farm ponds and planting them for wildlife.

THE EFFECTS OF HUNTING AND PREDATION ON QUAIL POPULATIONS

Hunting Effects

Although many people believe hunting is a major factor in decreasing the quail population, there seems to be little justification for this belief in Payne County. For example Carberry's Farm, because its high quail population was well known to local sportsmen, had a higher than average hunting pressure during the fall. One covey was shot down to three birds and these succumbed during the cold weather. Another covey came through with only three birds. This last covey was of particular interest because its territory was located in an isolated part of the farm. The following summer three broods were produced in this territory. How did this happen? Other pairs moved in from other territories, supplemented the three remaining birds, and produced young. Similar situations were witnessed throughout Payne County. Areas that had great losses in population in the fall and winter had as many birds as ever a year later, provided the habitat was of as high quality as it had previously been, and, of course, with no artificial liberation of any birds whatever.

Predation Effects

The quail population in the 15 territories studied was relatively stable during the fall and early winter despite the fact that predators were ever present. (See discussions of covey territories, pp. 14-27 and table 2, appendix). But during the critical period of weather when the quail were weak the predators became active and effective. Many coveys suffered high losses during this one week of extremely cold weather in January and February 1949. This was the only

time during the entire study when predation had any great effect; furthermore, those territories that provided satisfactory food and cover came through without any losses. It all boils down to one thing - ordinarily where the habitat is sufficient there will be quail regardless of predators or hunting.

QUAIL AND LAND CAPABILITY CLASSIFICATION

An attempt was made to correlate the abundance of quail with the Soil Conservation Service's land capability classes as found on each of the ten study areas. On the ten study areas the following three out of eight recognized land capability classes, described by Soil Conservation Service (1948), were represented:

Class I - Nearly level bottomland and upland soils with little or no erosion. Needs only good farming practices to keep up soil productivity.

Class III - Usually sloping or moderately eroded, fairly productive land and suitable for cultivation with intensive soil conservation treatments.

Class VII - Steep eroded, rough or very shallow land suitable for moderately productive pasture or woodland with intensive soil conservation treatment.

While some interesting relationships developed as the result of this approach to the problem of quail abundance it was decided that there were too many variables involved to make a definite correlation. For example, two farms, Drake's and Carberry's, having the largest amount of Class I land, also had the greatest quail populations; in fact, these quail concentrations were located in the areas having the Class I land. However, in the case of the Drake Farm, the territories were also in the lowland, ungrazed timbered ravine area and had the best pattern of vegetation sub-types. Similarly, on the Carberry Farm the good quail area was located in the bottomland, timbered ravine area and had the best interspersion of vegetation sub-types. Another area (Pickering Farm), having a large proportion of Class I and Class III land, but clean farmed, had no quail during the winter. The quail broods moved off the farm in the fall to the timbered ravine which had a great proportion of cover and Class VII land. This upland farm was almost completely lacking in cover, thus

introducing the land use factor into the picture. The farm (Willis McBride II), having all Class VII land also, had a poor quail population; on the other hand this area had a poor pattern of vegetation sub-types except where the covey territories were located.

From the above examples one gathers that, everything else being equal, Class I land has a greater quail productive capacity than does any other class. This statement accords with common sense as Class I land is more fertile and can produce a greater crop of seeds and plants in general - thus providing more quail food and cover.

NESTING AND POPULATION STUDIES ON CARBERRY FARM

Approximately five summer months (April-August, 1949) were spent studying quail nesting and broods. The purpose of this investigation was to determine the distribution and population of quail on a certain area following spring breakup; to determine the quail nesting requirements; and to determine the habitat requirements of the broods.

Spring Breakup

As spring approached coveys could be found in the upland coverless areas away from their traditional headquarters. Accompanying this change in habitat was a change in diet - they began eating tender green leaves of the new vegetation. When flushed they would remain separated for long periods of time, making no attempt to reform their covey until nightfall.

An attempt was made by the writer to mark and band all the coveys in this territory in order to aid distributions studies. Trapping was started too late for good results; only seven birds from territory 5 were caught, marked, and banded. The following band numbers and information were recorded:

Band No. 301	Age not recorded	April 11, 1949
Band No. 302	Adult	April 17, 1949
Band No. 303	Immature	April 17, 1949
Band No. 304	Immature	April 17, 1949
Band No. 305	Immature	April 17, 1949
Band No. 306	Age not recorded	April 17, 1949
Band No. 307	Immature	April 11, 1949

The adult quail carrying band number 302 was retrapped 200 yards from the original trap site in November 1949.

The first indication of spring breakup was evidenced on April 20 when the first bobwhite call was heard. The last observation of a covey formation was April 24 when seven birds were flushed in covey territory 5.

Nesting

The peak in whistling activity was reached around the 18th of May. A two week period of heavy rain slowed the nesting activity, as was evidenced by the reappearance of many pairs, where previously only males had been flushed, and, by an increase in whistling activity following the rain. Further evidence of this disturbance to nesting was indicated in the followed egg laying record at the State Game Farm at El Reno, supplied by Dick Jones, Game Farm employee.

Week of May 16 - 8810 eggs - week before rain
Week of May 23 - 6912 eggs - week during rain
Week of May 30 - 6800 eggs - week during rain
Week of June 6 - 8810 eggs - week after rain

During the nesting season quail were distributed over the entire 160 acres. The heaviest concentration of pairs was located in the 10 acre weeping love-grass meadow (Fig. 11). Three pairs and several unmated cocks inhabited this grass.

One unmated cock, identified by its squeaky bobwhite call, was observed throughout the summer. The maximum distance it traveled from its original starting point was approximately one mile. Its search for a mate started and ended on Carberry's Farm, but some of this time was spent on the farms to the west and south.

Six nests were located by hearing the females calling while incubating. This call was a low, two-note covey call (Stoddard, 1936, pp. 105-107). When it was given all males in the area, including the mated cock, would respond by bobwhiting, covey calling, caterwauling, and by flying into the nesting area. The first nest was found June 4. The peak of nesting was reached about June 18. Of the six nests found four were successful; the eggs of one were eaten by ground squirrels (Citellus sp.); and the other was abandoned.

Fig. 11. Site of bobwhite quail nest in Weeping Lovegrass meadow, Carberry Farm.

Broods

The majority of broods were hatched early in July. Eight distinct broods were located, four of which were followed daily from July 1 to August 15.

During the first week the cover requirements of broods were easily met by such non-woody cover as wheat, grasses, sunflowers, and other forbs. By three weeks of age they were settled in a temporary range which had woody cover.

The adults of two broods slowly divorced themselves from their broods when they were about 4 weeks of age. This was evidenced by the flushing site of the adult being farther and farther from that of the brood, until, finally they no longer were flushed with the brood. Also, at first the females would flush in the same direction as the brood, but later they made no attempt to fly with their young.

Weeping Lovegrass

A ten-acre field of this grass was excellent cover for bobwhite during the nesting season. It was planted in rows and harvested annully, thus allowing the quail freedom of movement on the ground. Its rank growth and the drooping character of the plants, which resulted in a thick canopy, afforded protection from above. Quail responded to this protection as was evidenced by the activity of three pairs and several unmated cocks. Three nests, two broods, roosting and dusting sites, and other signs were found in this ten acre meadow.

The lovegrass nests were different from the typical quail nests in that they were built under last years bunches of hay that had been accidentally left behind during the harvest. A small tunnel lead into the nest proper, which could not be seen from any angle unless the mass of hay were lifted. A love-grass nest is compared with an ordinary nest in Figs. 12-13. These unusual

Fig. 12. Bobwhite quail nest in Ungrazed Tall-grass Sub-type, Carberry Farm.

Fig. 13. Entrance tunnel to bobwhite quail nest in Weeping Lovegrass, Carberry Farm.

nests were very similar to those of the Texas cotton rat (Sigmodon hispidus texianus), which were abundant in the lovegrass. They could be distinguished by the fact that cotton rats cut their nesting material into small pieces while quail used the entire piece. They both dig cup shaped holes into the ground, but those of the quail were deeper.

Population Studies

The 1948 fall population on Carberry's Farm included five coveys totaling 66 birds. This represented a bird per 2.4 acres; however, two of the coveys ranged off the farm occasionally; consequently, 200 acres were used instead of 160, thus making the population one bird per 3 acres. The 1949 spring population was four coveys representing 26 birds - a loss of 40 birds. Of these 40 birds, thirty-four were known to have been killed - twenty by weather, and 14 by hunting. An estimate of 33 quail, 20 males and 13 females, was made following the 1949 spring breakup. This indicated an influx of seven quail.

Eight separate broods were contacted during the summer. This meant that at least eight pairs were successful in bringing off young. Six broods remained by August. The 1949 fall population was four coveys totaling 52 birds.[1] This represented one bird per 3 acres figuring on the basis of 160 acres, or one bird per 3.8 acres on the basis of 200 acres. This was one covey or 14 birds less than the 1948 fall population. Since the summer nesting season was good, this decrease in population can be attributed to the destruction of habitat by land use practices. (See discussion of covey territories 2, 3, 4, pp. 15-16).

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[1] The 1949 fall population figures were contributed by P. L. McNeil, Unit Fellow, Oklahoma Coop. Wildlife Research Unit, Oklahoma A. and M. College.

A breakdown of the population figures is given in the table below.

TABLE 2

QUAIL POPULATIONS ON CARBERRY'S FARM
FALL 1948-FALL 1949

Territory	Fall 1948 No.	No. Killed		Spring 1949 No.	Summer 1949 No.	Broods Summer	Fall 1949 No.
1	20	Shot	5	3	13 pairs and 7 unmated cocks on the entire farm	8 broods found on entire farm, only 6 were found later	15
		Weather	12				
2	9	Shot	5	0			
		Weather	3				
3	12	Weather	5	7			
4	15	Shot	4	5			9
							13
5	10			11			15
	66		34	26	33	8	52

SUMMARY AND CONCLUSIONS

The following conclusions are based upon the results from a one-year study of bobwhite populations and ecological relationships. They apply to the Tallgrass Prairie and Post Oak-Blackjack Oak game types in Payne County, and, presumably to similar areas in North-central Oklahoma.

1. Five of 24 habitat improvement areas and five unimproved check areas were selected for evaluation studies in Payne County in the fall of 1948. Fifteen bobwhite covey territories, on or surrounding the ten study areas, were located and defined.

2. The vegetation on these ten areas and fifteen territories was mapped and classified into nine vegetation sub-types.

3. The bobwhite quail, in this area, was found to be a bird of vegetation type or sub-type edges.

4. Amount of edge per acre is an indicator of quail territory. The average edge per acre in quail territory on the areas studied was 97 yards, while that of non-quail territory was 60 yards. Individual territories had a higher edge per acre than the study areas around them, showing that the birds were where the most edges were.

5. Timbered ravine, hedges and thickets, forbs and ungrazed tallgrass were the most important sub-types for quail.

6. Cultivation, grazing, clearing ravines of protective and productive vegetation, cutting out hedges, thickets and weed patches, and burning affected and often impaired, the quality of the sub-type for quail.

7. Predation had little effect on the fall and winter coveys when the habitat was good.

8. Hunting and weather in this area did not affect the following years quail population. The number of the birds was maintained wherever the food and shelter were maintained.

9. Natural production of wildlife on Class VIII land, as suggested by the Soil Conservation Service, is impossible. Quail is a crop, and as such does best on fertile land.

10. Six nests were located by hearing females calling while incubating. This is a new method of locating nests that appears to have definite advantages over other known techniques.

11. Weeping lovegrass proved to be important nesting cover for quail. The nests found in this grass were different from ordinary quail nests, but were similar to cotton rat nests.

12. The 1948 fall quail population on the Carberry Farm was one bird per 3 acres; in 1949, despite the high production of young, it was one bird per 4 acres. Land use practices and plant succession had lowered the fall carrying capacity in 1949 and the anticipated trend is downward as cultivation becomes more intensive.

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APPENDIX

Maps of Vegetation Sub-types

Bobwhite Quail Study Areas

Payne County, Oklahoma

Maps 1-10

Legend

Oak Woodland

Timbered Ravine

Hedges and Thickets

Grazed Tallgrass

Ungrazed Tallgrass

Grazed Shortgrass

Ungrazed Shortgrass

Forbs

Cultivation

MAP 1

Carberry Farm, (NW¼ of S24-T19N-R1E), October 1948

For legend see appendix, p. 51

Also see text, p. 14

MAP 2

Murphy Farm. (NE¼ of S25-T19N-R2E), October 1948

For legend see appendix, p. 51

Also see text, p. 17

MAP 3

McBride Farm I, (NE¼ of S36-T19N-R1E), October 1948

For legend see appendix, p. 51

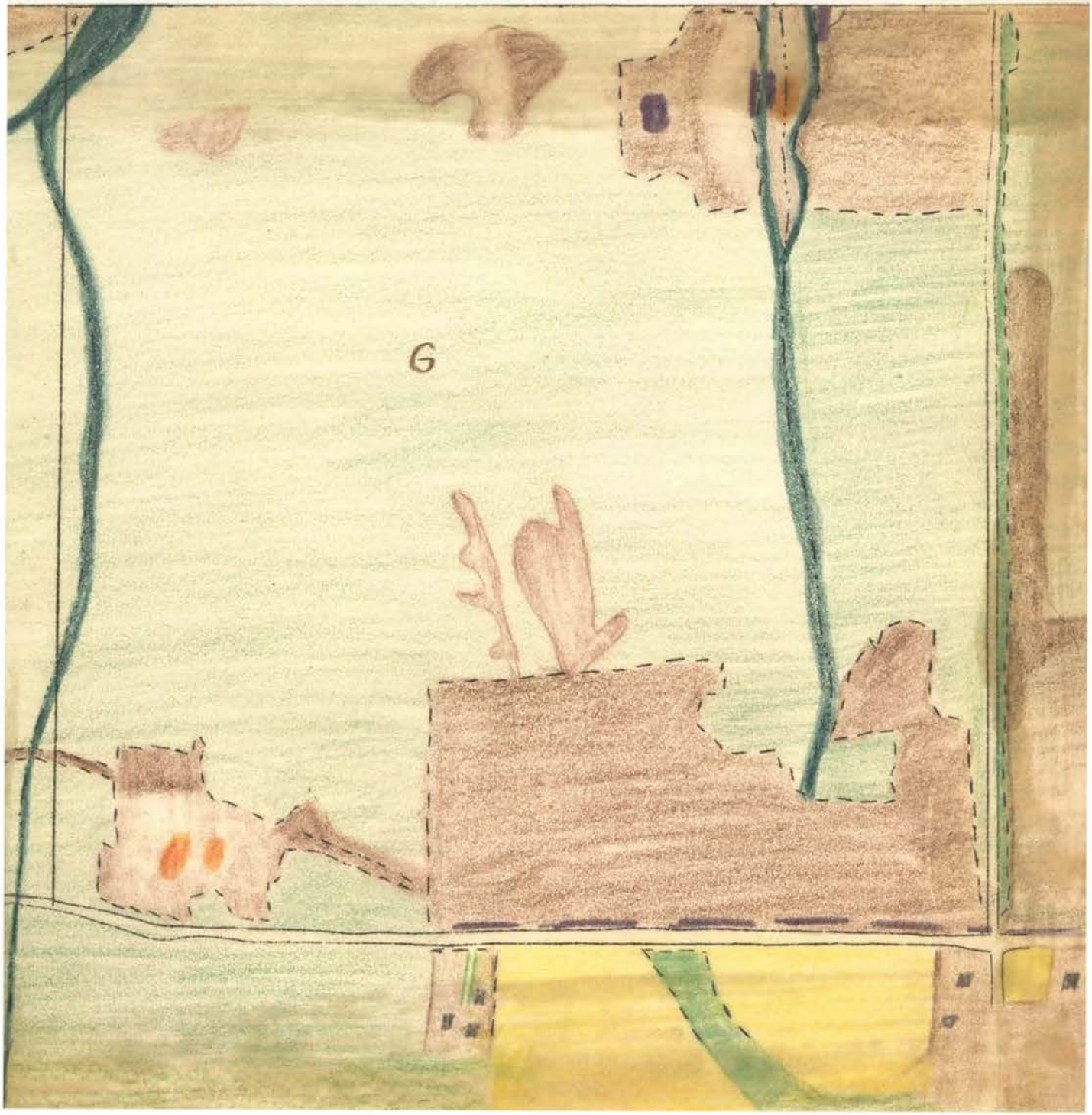
Also see text, p. 18

MAP 4

McBride Farm II, (SE¼ of S36-T19N-R1E), October 1948

For legend see appendix, p. 51

Also see text, p. 19



MAP 5

Brewer Farm, (SW¼ of S20-T19N-R4E), October 1948

For legend see appendix, p. 51

Also see text, p. 20

MAP 6

Pickering Farm, (NE¼ of S29-T19N-R4E), October 1948

For legend see appendix, p. 51

Also see text, p. 22

MAP 7

Kirk Farm, (SE¼ of S35-T18N-R3E), October 1948

For legend see appendix, p. 51

Also see text, p. 23

MAP 8

Story Farm, (NW¼ of S1-T17N-R3E), October 1948

For legend see appendix, p. 51

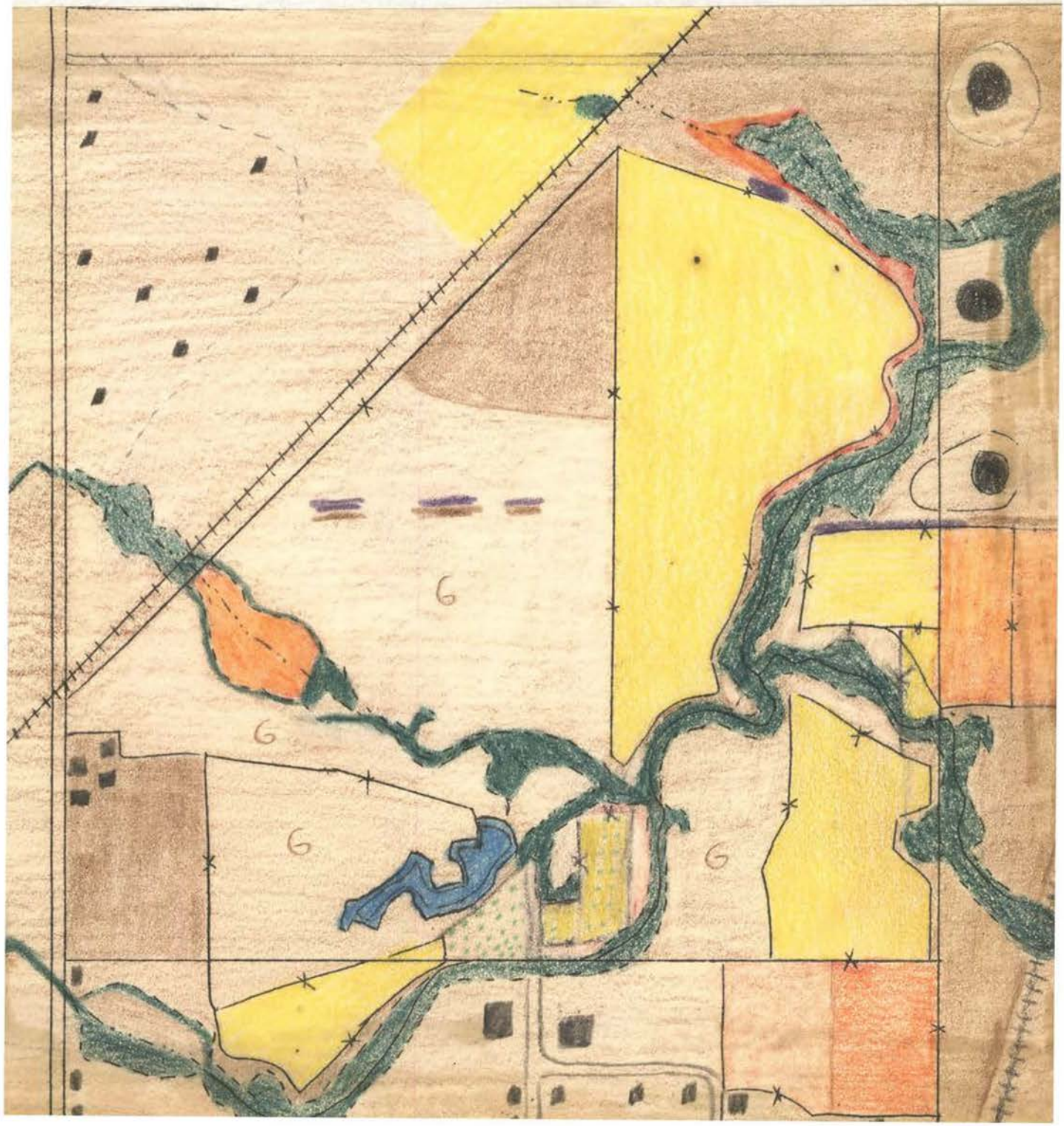
Also see text, p. 25

MAP 9

Drake Farm, ($S\frac{1}{2}$ of $NW\frac{1}{4}$ and $N\frac{1}{2}$ of S27-T18N-R5E), October 1948

For legend see appendix, p. 51

Also see text, p. 25



MAP 10

Alles Farm, (SW¼ of 26-T18N-R5E), October 1948

For legend see appendix, p. 51

Also see text, p. 27

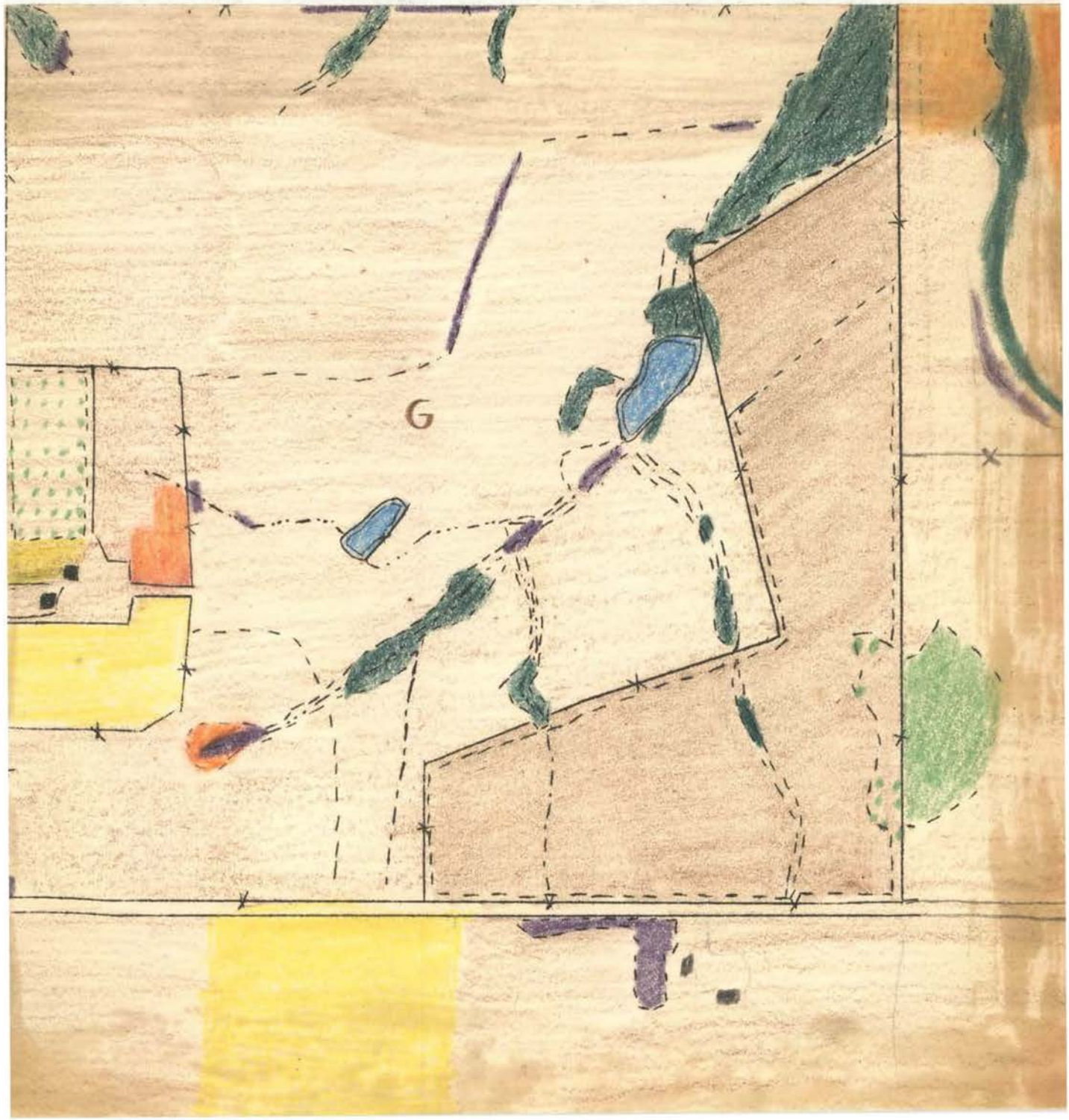


Fig. 14. Differences in percentages of 9 vegetation sub-types in study areas in Payne County, Oklahoma, compared with the same vegetation sub-types in 15 quail territories.

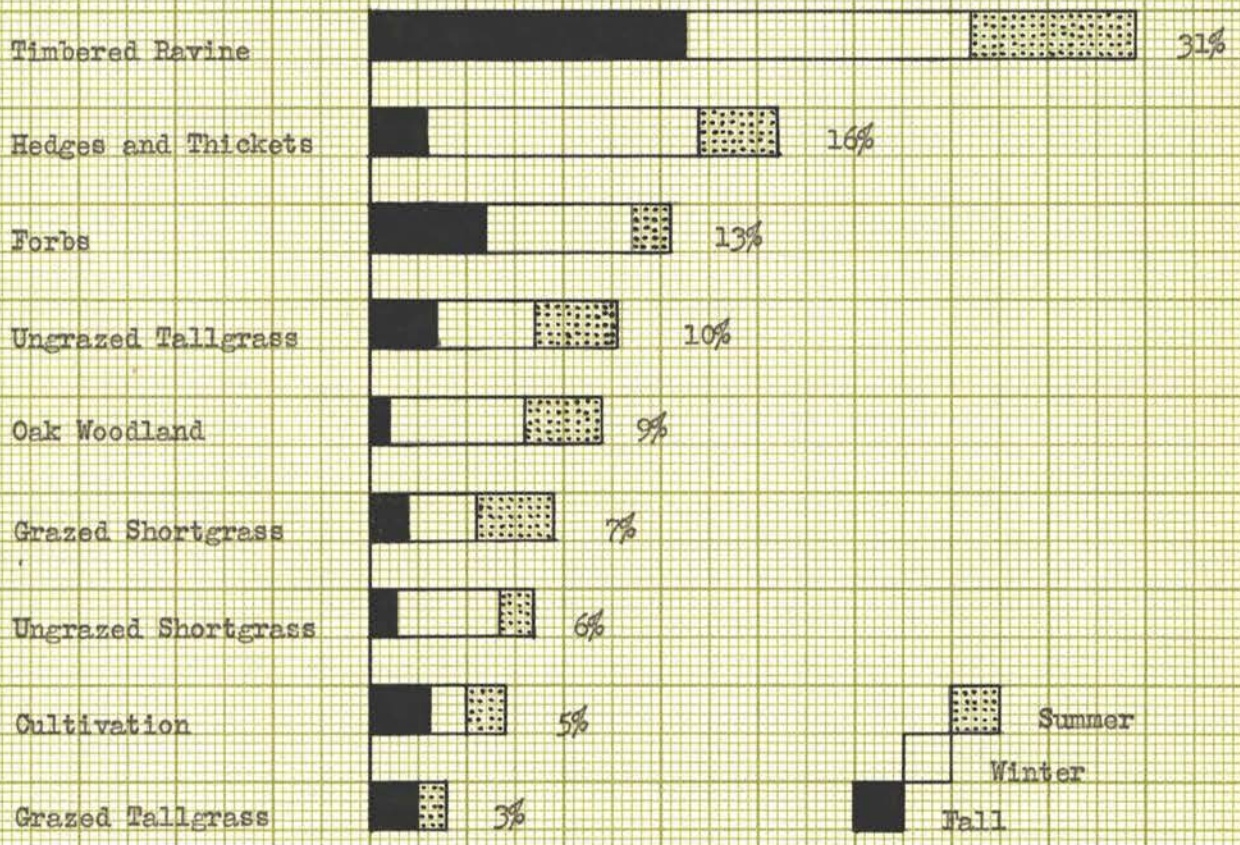


Fig. 15. Relative and seasonal importance of 9 vegetation sub-types to bobwhite quail in Payne County, Oklahoma, October 1, 1948 to October 1, 1949, based on 204 flushes of 19 coveys located on 10 areas.

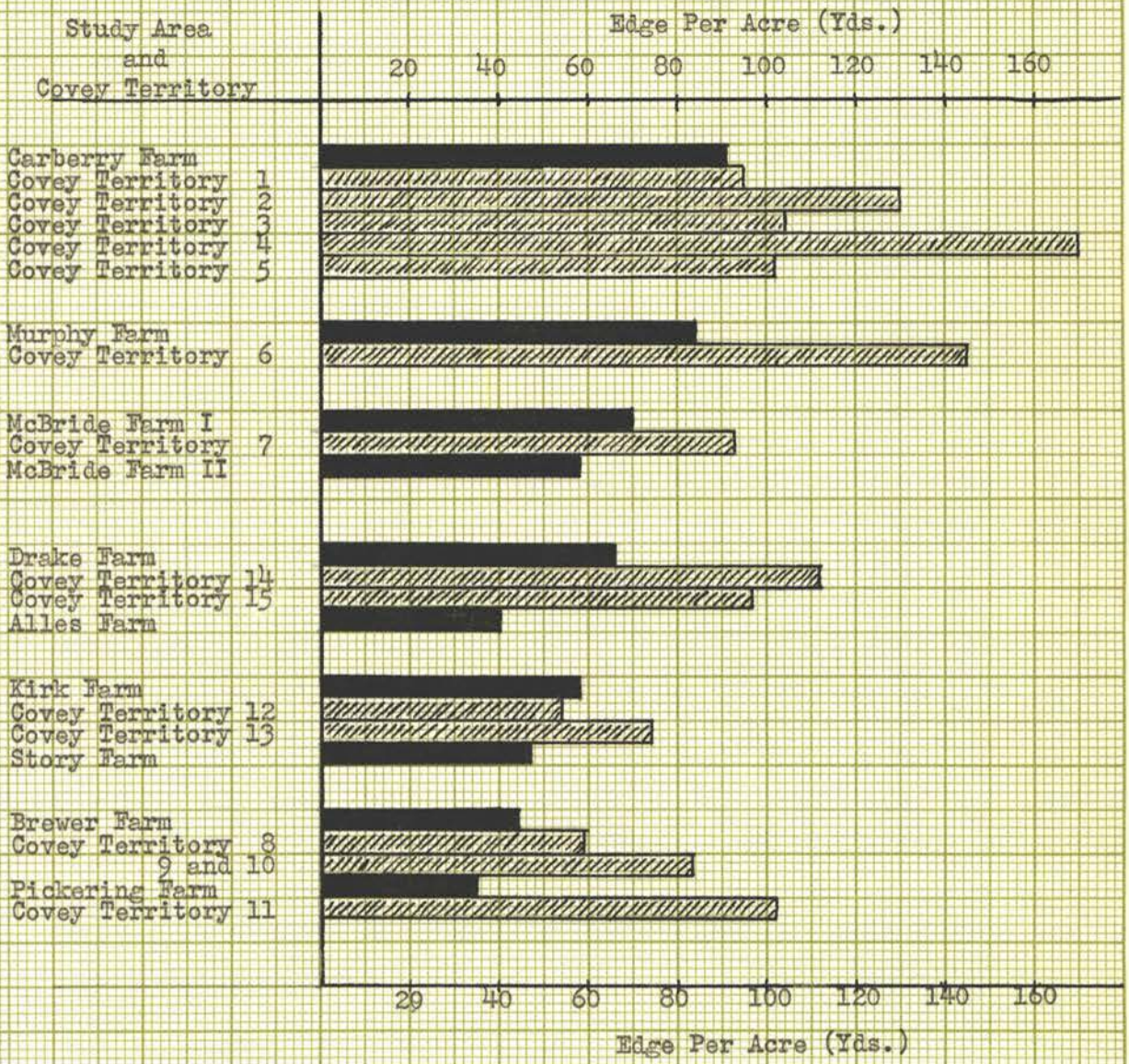


Fig. 16. Comparison of the edge per acre afforded by 15 covey territories with that of their nearest study areas.

Bobwhite Quail

Flush Sheet

Location: County_____ S_____ T_____ R_____ Date_____

Time of Day _____Precipitation_____Wind_____

Ground Condition_____

Notes on Plant Growth,etc._____

_____

Cover: Crown_____

_____

Under_____

_____

Ground_____

_____

Situation_____

_____

_____

Number in Covey_____ Accuracy of Count_____

Condition_____

_____

Activity_____

_____

_____

Notes_____

_____

_____

Remarks_____

_____

Fig. 17

_____

_____

TABLE 3

ACRES AND AMOUNT OF EDGE OF 9 VEGETATION SUB-TYPES
WITHIN 15 QUAIL TERRITORIES IN PAYNE COUNTY, OKLAHOMA

Territory	1	2	3	4	5	6	7
Timbered Ravine							
Acres	6.5	5.0	2.3	8.0	15.0	13.3	6.0
Edge (Yds.)	1,724.8	1,126.4	633.6	1,619.2	2,675.2	3,942.4	1,830.4
Oak Woodland							
Acres	4.0		4.7	1.0	3.0		22.0
Edge (Yds.)	704.0		281.6	422.4	422.4		1,548.8
Hedges and Thickets							
Acres	1.0	0.5	1.8	0.5	1.0	1.2	1.0
Edge (Yds.)	633.6	633.6	985.6	281.6	1,126.4	1,267.2	985.6
Grazed Tallgrass							
Acres	12.5	1.5	8.0	5.0	5.0	1.5	12.0
Edge (Yds.)	605.4	211.2	985.6	1,056.0	1,478.4	281.6	1,971.2
Ungrazed Tallgrass							
Acres	14.0	3.0	7.9	4.0	12.0	4.0	
Edge (Yds.)	2,956.8	985.6	2,252.8	844.8	1,830.4	1,830.4	
Grazed Shortgrass							
Acres	12.5		8.0		9.0	16.0	2.0
Edge (Yds.)	1,689.6		1,337.6		1,126.4	2,956.8	352.0
Ungrazed Shortgrass							
Acres	5.0			0.5	1.0	4.0	
Edge (Yds.)	1,408.0			211.2	352.0	281.6	
Forbs							
Acres	3.0	5.0	5.0	4.0	1.0	7.0	2.0
Edge (Yds.)	1,408.0	1,689.6	2,534.4	2,675.2	352.0	2,816.0	1,548.8
Cultivation							
Acres		10.0	9.3	2.0	5.0	5.0	
Edge (Yds.)		1,830.4	774.4	1,408.0	1,196.8	1,685.6	
Total							
Acres	58.5	25.0	47.0	25.0	52.0	52.0	45.0
Edge (Yds.)	11,130.2	6,476.8	9,785.6	8,518.4	10,560.0	15,061.6	8,236.8

TABLE 3--Continued

8	9-10	11	12	13	14	15	Total	Edge/ Acre (Yds.)
0.7	7.3	9.5		6.0	9.0	8.0	96.6	
563.2	3,379.2	2,956.8		1,337.6	2,816.0	2,252.8	26,857.6	278
		0.3					35.0	
		70.4					3,449.6	99
2.3	1.0	4.0	1.0	1.0	2.6	1.0	19.9	
1,689.6	1,548.8	2,956.8	1,056.0	1,126.4	2,534.4	985.6	17,811.2	895
35.0	12.0	14.0				4.0	110.5	
2,534.4	1,689.6	1,548.8				985.6	13,347.8	121
	6.0	6.0	10.0	20.0	11.9		98.8	
	844.8	844.8	985.6	2,534.4	1,548.8		17,459.2	177
9.0	29.0	14.0	3.0	4.0		5.0	111.5	
704.0	3,379.2	2,252.8	281.6	422.4		563.2	15,065.6	135
	5.0				11.0		26.5	
	774.4				1,548.8		4,576.0	173
24.0	7.0		21.0	12.5	1.0	8.0	100.5	
1,126.4	422.4		1,480.0	1,056.0	281.6	844.8	18,235.2	181
6.0	10.7	13.0			9.5	14.0	84.5	
2,534.4	943.4	1,830.4			1,337.6	2,112.0	15,653.0	185
77.0	78.0	60.8	35.0	43.5	45.0	40.0	683.8	
9,152.0	12,981.8	12,460.8	3,803.2	6,476.8	10,067.2	7,744.0	132,455.2	
							683.8	
							66,227.6	
							97.0	Edge/ Acre
							49.0	Acres

TABLE 4

ACRES, AMOUNT OF EDGE, AND EDGE PER ACRE RATIO AFFORDED BY 9 VEGETATION SUB-TYPES ON 10 STUDY AREAS IN PAYNE COUNTY, OKLAHOMA WITH THE TOTAL EDGE PER ACRE RATIO OF EACH STUDY AREA

Study Area	C.R. Carberry Farm	W.B. Murphy Farm	W.McBride Farm I	W. McBride Farm II	V. Brewer Farm
Timbered Ravine					
Acres	15.0	13.0	23.0	5.0	1.0
Edge (Yds.)	2,956.8	5,350.4	5,772.8	2,956.8	985.6
Oak Woodland					
Acres	4.0		105.0	112.0	
Edge (Yds.)	844.8		9,574.4	6,899.2	
Hedges and Thickets					
Acres	4.0	3.0	1.0	1.0	2.0
Edge (Yds.)	2,816.0	2,393.6	844.8	1,408.0	1,126.4
Grazed Tallgrass					
Acres	34.0		17.0	33.0	63.0
Edge (Yds.)	6,758.4		2,675.2	3,801.6	4,505.4
Ungrazed Tallgrass					
Acres	33.0	45.0			17.0
Edge (Yds.)	5,068.8	5,209.6			1,548.8
Grazed Shortgrass					
Acres	24.0	49.0	11.0	7.0	19.0
Edge (Yds.)	3,379.2	5,491.2	2,252.8	2,534.4	2,112.0
Ungrazed Shortgrass					
Acres	6.0	5.0			
Edge (Yds.)	1,830.4	844.8			
Forbs					
Acres	11.0	5.0	3.0	2.0	22.0
Edge (Yds.)	2,956.8	3,097.6	1,126.4	985.6	1,689.6
Cultivation					
Acres	29.0	40.0			36.0
Edge (Yds.)	2,534.4	4,646.4			2,112.0
Total					
Acres	160.0	160.0	160.0	160.0	160.0
Edge (Yds.)	29,145.6	27,033.6	22,246.7	18,585.6	14,080.0
Total Edge/Acre (Yds.)	91.0	84.0	70.0	58.0	44.0

TABLE 4--Continued

R. Pickering Farm	L. Kirk Farm	J. Story Farm	W.A. Drake Farm	E. Alles Farm	Total	Edge/ Acre (Yds.)
1.0	3.0	4.0	15.0	5.0	85.0	
704.0	1,689.6	2,252.8	4,364.8	1,267.2	28,300.8	333
	14.0	44.0			279.0	
	1,971.2	2,956.8			22,246.0	80
1.0	3.0	1.0	1.0	4.0	21.0	
985.6	1,689.6	985.6	704.0	2,393.6	15,347.0	730
	21.0				168.0	
	1,408.0				19,148.6	111
37.0		10.0	10.0	30.0	182.0	
2,534.4		1,126.4	1,830.4	2,252.8	19,571.2	108
46.0	84.0	48.0	57.0	109.0	454.0	
4,083.2	6,617.6	3,660.8	6,899.2	6,054.4	43,084.8	95
					11.0	
					2,675.2	243
	18.0	3.0	1.0	1.0	66.0	
	3,379.2	704.0	1,267.2	281.6	15,488.0	235
75.0	17.0	50.0	76.0	11.0	334.0	
2,816.0	1,689.6	3,379.2	5,913.6	1,408.0	24,499.2	73
160.0	160.0	160.0	160.0	160.0	1,600.0	
11,123.2	18,444.8	15,065.6	20,979.2	13,657.6	190,361.0	
35.0	58.0	47.0	66.0	43.0	59.0	Edge/ Acre

Leota L. McOsker