

COMPONENTS OF THE HABITAT OF THE BOBWHITE QUAIL,
IN PAYNE COUNTY, OKLAHOMA

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CHAPTER I

INTRODUCTION

One result of the popularity of the bobwhite as a game bird has been the numerous studies concerned with various features of its ecology. In addition, large sums have been spent on habitat development (Nelson, et al., 1960) intended to elevate carrying capacity. In spite of the research and development mentioned above, there is evidence that the commonly-employed practices of establishing so-called or potential food and cover plants have not materially benefited the species (Marshall, 1953; Gehrken, 1956; Wunz, 1959). Management techniques presently employed may result in higher quail populations in some instances (Scott and Klimstra, 1954; Steele, 1960; Wilson and Vaughn, 1944). Frye (1961) concludes, however, that these are much too expensive for widespread application, and that most hunters harvest birds available as a result of no particular or direct effort toward the enhancing of their habitat.

One present need appears to be for a simple, widely-applicable method of identifying the bobwhite's habitat. In order to do this, it is necessary to be able to recognize individual habitat components (Stebler, 1958), or specialized places (Leopold, 1933). This report summarizes research directed at providing a basis for description of places used by bobwhites for roosting, daytime resting, dusting, escape, foraging and whistling. Local food use is also reported, with the food resource being recognized as a part of the foraging component.

A major problem encountered in attempting to describe the habitat of a given animal species is the lack of adequate methods. Emlen (1956) and Elton and Miller (1954) have suggested techniques for use by animal ecologists in describing vegetation. These methods, however, offer procedures for characterizing the general area where a species is found, rather than a means of describing the actual habitat of that species. In the present study, a modification of Emlen's mensurational approach was used. It was applied, however, only to the habitat of the bobwhite — those places actually used by the birds.

Field work was conducted from July of 1961 to January of 1963. Laboratory work in connection with food-use analysis was conducted concurrently and at the close of this period.

The study was supported by the Oklahoma Cooperative Wildlife Research Unit¹ and the National Wildlife Federation and carried out with the counsel and advice of my major Adviser, Dr. A. M. Stebler. Members of my advisory committee, Drs. F. M. Baumgartner, D. D. Dwyer, H. I. Featherly, B. P. Glass and R. R. Walton, were consulted freely. Messrs. Carl Baucom, George Cooper, H. M. Delozier, John O'Lary, R. T. Lawler, and J. M. Springer made their lands available for this study.

¹Oklahoma Department of Wildlife Conservation, Oklahoma State University, U. S. Fish and Wildlife Service, and Wildlife Management Institute cooperating.

CHAPTER II

DESCRIPTION OF THE STUDY AREAS

Bruner (1931), Blair and Hubbell (1938), and Duck and Fletcher (1943 and 1944) have classified the vegetation of Oklahoma. Curtis and Ham (1957) have provided a view of the physiography of the state. The present study areas were located near the Lake Carl Blackwell Area, in Payne County, and are described below.

Main Study Areas

The three main study areas furnished all the data on food use, and the greater part of the data regarding cover. These areas comprised parts of Sections 19, 20, 29 and 30-T19N-R1E, as shown in Fig.1. Ecological situations represented were cropland, post oak-blackjack oak upland, and bottomland timber. The study area boundaries delimit the areas of principal use by bobwhites.

Baucom Farm Study Area

This area was mostly cropland, with the northeastern two-thirds being planted to wheat in season. The remainder was fallow during the course of the study, and the entire area of cropland was fallow except during the wheat-growing season. The wheat was cut in late June and the field was subsequently dominated by herbaceous species including trailing wildbean, goldenweed, fringleaf paspalum, sunflower, croton,

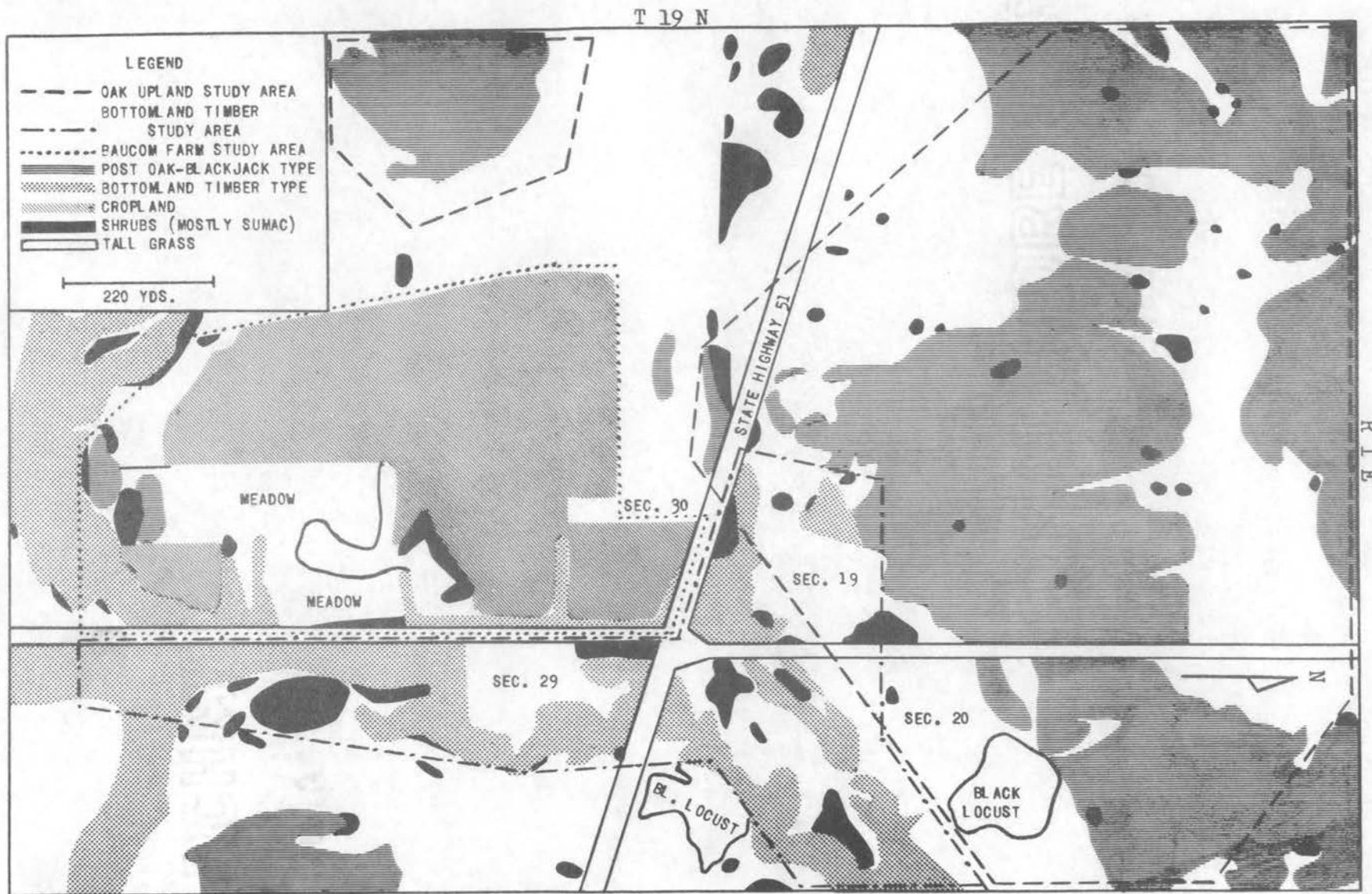


Fig. 1. Main study areas, showing vegetational distribution -- Payne County, Oklahoma.

flower-of-an-hour and rough buttonweed.² The area that was fallow year around was mostly dominated by goldenweed, terragon snakeweed, and prairie threeawn. Fringeleaf paspalum was scattered in this area, and several clumps of johnsongrass were present. About one-half of the small field in the southeastern corner of the study area was covered by an erect growth of mat sandbur, and the remainder was dominated by hairy crabgrass, rough buttonweed, aster and trailing wildbean.

A block of regularly mowed meadow was present in the southeastern part of the study area, with areas of unmowed tall grasses immediately to the north and to the southwest.

The fencerows and ravines were generally dominated by American elm, hackberry, roughleaf dogwood, Chickasaw plum, and sumac. The trees were mostly of low growth, with limbs extending near the ground. The presence of the shrubs added to this effect. Two small, open clumps of low-growing oaks were present, and clumps of sumac were scattered in several locations.

Oak Upland Study Area

This area was composed principally of woodland dominated by low-crowned, low-branching post oak and blackjack oak in generally open stands, with a spotty understory of coralberry and with clumps of sumac scattered throughout. The woodland was interrupted by numerous openings of varying area. The larger ones were abandoned cropland now dominated by tall grasses including little bluestem, silver bluestem and yellow indiagrass. They also contained a variety of other plants scattered in small stands

²See Appendix A for a list of common and scientific names of plants appearing in this report.

presumably a result of different degrees of slope, drainage, and soil depth. These included johnsongrass, western ragweed, fringleaf paspalum, lespedezas and showy partridgepea.

Numerous openings too small for inclusion in Fig. 1 were scattered through the woodland. Many of these were created by continuous cutting for firewood. Plant growth in such openings was variable, depending upon area, age, and perhaps other factors. Panicum grasses were abundant in some of these, and under the taller oaks. Sumac clumps were common in openings of various sizes. Three very narrow ravines ran through the woods. Grazing was very light, and no part of the area was under cultivation.

Bottomland Timber Study Area

This was a narrow, sparsely wooded area dominated by American elm, eastern poplar and eastern black walnut. The smaller trees, together with a scattered understory and fringe growth variously composed of eastern redcedar, roughleaf dogwood, coralberry and greenbriar, provided considerable growth near the ground. This effect was accentuated by an unevenly distributed ground cover of broadleaf uniola, white crownbeard, bedstraw, nimblewill and other herbaceous plants. Tangles of grape were not uncommon, and clumps of sumac were again scattered in openings. Luxuriant stands of tall grasses, dominated by yellow indiagrass, blue-stems and johnsongrass, were present along the fringes of the bottom.

Topography was variable even in this comparatively wet situation. Openings on higher sites supported quail foods including western ragweed, fringleaf paspalum, panicum grasses, lespedezas and silver nightshade.

Grazing was light in overall effect, but in fall and winter was

destructive of the limited stands of johnsongrass.

Supplemental Study Areas

These areas provided some of the data pertaining to cover. They were located a short distance west of the main study areas, and represented abandoned farmland, tall grass prairie, and timbered bottomland.

Lawler Farm Study Area

This area of recently abandoned farmland was located just north of State Highway 51, in the NW 1/4-Sec. 24-T19N-R1W, and included a few acres in the SE 1/4-Sec. 14. The study area was centered on a wooded ravine that ran southeasterly. The ravine originated as a wide, flat drainage dominated by western ragweed, bristlegass and dropseed, and dotted with low clumps of osageorange and coralberry. The drainage deepened slightly and was covered at one point by a dense stand of shrubby indigo amorpha. Further on it changed into a narrow, deeper ravine fringed with an open stand of American elm, eastern poplar, rough-leaf dogwood, indigo amorpha and eastern redcedar. The appearance of low woody growth was accented by the fact that some of these plants grew in the ravine itself, and their lower limbs extended to ground-level. Several clumps of sumac were present.

Two unoccupied farmsteads were present, one on either side of the ravine. The one on the southwestern side included about four acres of intermixed tall grasses and forbs, and several more acres of abandoned cropland dominated by silver bluestem and prairie threeawn.

The farmstead on the northeastern side of the ravine provided a more varied ecological situation, and received most of the bobwhite use.

An old barnyard on low ground adjacent to the ravine supported a dense stand of johnsongrass and lambsquarters goosefoot interspersed with eastern redcedar. The hill that the house occupied was rocky and eroded, and supported a variable stand of herbaceous plants dominated by western ragweed, silver bluestem, fringleaf paspalum, hairy crabgrass, dropseed and terragon snakeweed. The slope between the house and the ravine supported a less varied stand of herbs dominated in spots by tall grasses, terragon snakeweed, and prairie threeawn. The upper end of the ravine was grazed, but the remainder of the area was not in agricultural use during the period of the study.

Tall Grass Prairie Study Area

This area was located between two arms of Lake Carl Blackwell and occupied the SW 1/4-Sec. 12-T19N-R1W. Most of the area was dominated by little bluestem and yellow indiagrass. Places of particular significance during summer and early fall were small, open groves of low-growing, limby post oak and blackjack oak with considerable sprout growth. The oaks provided a scattered cover, and a greater variety of other plants were present among them than in the tall grasses. Notable among these were fringleaf paspalum, hairy crabgrass, lambsquarters goosefoot, common pokeberry, and bristlegrass.

A fringe of tree and shrub growth was distributed in a spotty fashion along the lakeshore. The introduction of a large herd of cattle later resulted in drastic reduction of the herbaceous vegetation in the oak-dominated areas. Bobwhite sign was lacking after this and the study area was abandoned.

Bottomland Timber Study Area

This area was centered on an intermittently-flowing tributary of Stillwater Creek, which formed the western extremity of Lake Carl Blackwell. It occupied the E 1/2, SE 1/4-Sec. 3 and W 1/2, SW 1/4-Sec. 2-T19N-R1W. This was a shallow drainage covered by an open, low-crowned stand of American elm, hackberry and willow. Small, shrubby clumps of roughleaf dogwood, indigo amorphia, coralberry and sumac were scattered among the trees and along the outer edges of the stand of trees.

Immediately west of the wooded drainage was a meadow about 200 yards wide, and west of this was a large field with sorghum patches at its north and south ends. On the east side of the drainage was a hill dominated by tall grasses interspersed with forbs and clumps of shrubs. The vegetation of the area has been described in detail by Goertz (1962). Across State Highway 86, in Sec. 2, was a lightly grazed pasture dominated by little bluestem and with a stand of black locust at the western edge, next to the highway. Several clumps of sumac and a fringe of johnsongrass bordered the south edge.

CHAPTER III

METHODS

Identification of Habitat Components

Places used for six different purposes were distinguished. The criteria used were:

1. Places Used for Roosting:

Birds found huddled together at daylight or dusk.

Small heaps of droppings found in areas where birds had been heard whistling at dawn or dusk, or to which they had been observed flying at dusk (Klimstra and Ziccardi, 1963:204; Wilson and Vaughn, 1944:86).

In the latter part of the study, small heaps of droppings found in open vegetation where bobwhites were known to roost or suspected of roosting.

2. Places Used for Daytime Resting:

Birds found sitting together in a group; in winter huddled together in roosting fashion.

Droppings in a small group, similar to a night roost but with fewer droppings (Errington and Hamerstrom, 1936:325).

In the latter part of the study, groups of droppings found in places where bobwhites were known to rest or suspected of resting.

3. Places Used for Dusting:

Presence of dusting spots (Stoddard, 1931:56); birds present or absent.

4. Places Used for Escape:

Places were noted where bobwhites took refuge upon being disturbed.

5. Places Used for Foraging:

Birds found in the presence of foods known to be utilized by bobwhites on the study areas.

Evidence of scratching (but not dusting), frequently in the presence of known food plants.

Relatively few droppings, scattered along with signs of scratching or about known food plants.

6. Places Used for Whistling:

Places occupied by male bobwhites giving the "bobwhite" call were noted.

Description of Habitat Components

At each place where the activity that the bird or birds had engaged in could be determined, using one or more of the above criteria, the following notes concerning the vegetation were made: height, per cent density at quail level, per cent overhead concealment (canopy) provided, life-form and species. Density and overhead concealment were determined by visual estimate. For each observation, vegetation described was that immediately surrounding the place of use, and the plant life-form recorded was the one furnishing the principal cover. For example, scattered high trees that contributed no cover to the

specific place under consideration were excluded from the notes.

The Du Rietz (1931:45) system of classifying plant life-forms was used, except that height of vegetation was measured or estimated, so that plants were not grouped into arbitrary height classes. Further, vines were considered a single life-form and were not classified as woody or herbaceous. In order to classify all items encountered, it was necessary to categorize fallen trees and human artifacts of various sorts.

Most of the data regarding places used for roosting, resting, dusting, escape and foraging are recorded in Appendix B, and all except plant names are summarized in the section on results. In the discussion, these data are compared with data from the literature in order to arrive at characteristics of habitat components that are applicable to bobwhite habitat in different parts of the species' geographic range.

Places used for roosting and for resting were in some instances recognizable as discrete units of cover. The widths of these units are recorded in the section on results. Data relating to whistling places are given in the same section.

Food Use Analysis

Volumetric measurements of crop and gizzard contents were secured by the aggregate volume method described by Martin, Gensch and Brown (1946). Similar data from droppings were secured by estimating the per cent composition of each sample and averaging percentages. Frequency data were obtained by recording the occurrence of individual foods in each crop, gizzard or droppings sample, and computing the per cent of the total number of samples in which the item occurred. Both volumetric

and frequency data were grouped according to season. Droppings were handled according to the technique of Wilson and Vaughn (1944).

Identification of food items was made by comparison of sample contents with a reference collection of seeds, fruits, leaves and insects taken from the study areas, and by comparison with seeds in the Wildlife Unit's collection and with keys and illustrations given by Borrer and DeLong (1954).

The food use section of the project was a study of limited scope, intended to identify some of the principal food resources of bobwhites in the local area, for comparison with foods used in other regions. As such, it made no attempt to sample the exact proportions of various foods taken.

The sample sizes employed are consistent with the above approach. Davison (1940) illustrates the need for a large series of sampling units in order to make a detailed evaluation of food items in a given area. His data show, however (p. 112), that in a series of 471 crops, the top-ranking items by volume were identified as such in various smaller samples.

Crop and gizzard samples were used for fall and early winter periods, and droppings samples were used for spring, summer and periods of snow cover. Doubtless the gizzard and droppings samples overemphasized the proportions of materials that were resistant to digestion.

CHAPTER IV

RESULTS

Habitat Components

Roosting

Most roosting spots were found in stands of erect herbaceous plants, usually bunchgrasses, about one meter in height, of at least 10 per cent density at ground-level, and providing little or no overhead concealment or obstruction. (Table I, Figs. 2, 3, 4). The grasses generally provided open spots between clumps large enough for roosting by a covey of bobwhites, even though overall density was sometimes high.

The favored roosting area of a covey on the Baucom farm was joined on one side by a mowed meadow and on another by a dense stand of johnsongrass. These two latter areas were generally avoided for roosting. The meadow vegetation was apparently too short to provide adequate concealment, and the johnsongrass formed a tight canopy of a type under which bobwhites seem reluctant to roost. After the johnsongrass was opened up by grazing in late 1962, it was used for roosting on several occasions.

Thirty-four different plants contributed to roosting cover. Little bluestem, mat sandbur, and yellow indiagrass were the species most used.

Use

TABLE I
 PER CENT FREQUENCY WITH WHICH CERTAIN ENVIRONMENTAL TYPES PROVIDED COVER
 AT ROOSTING PLACES OF BOBWHITES^a

Environmental Types	Main Study Areas			Supplemental Study Areas		
	n = 171 ^b Baucom Farm	n = 72 Oak Uplands	n = 60 Bottomland	n = 22 Lawler Farm	n = 22 Prairie	n = 66 Bottomland
<u>Plant Life-Forms</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
<u>Erect Herbaceous Plants</u>						
Grasses	85.9	95.8	96.6	59.1	100.0	87.9
Forbs	12.3	1.4	1.7	31.8	-	12.1
Subtotal	98.2	97.2	98.3	90.9	100.0	100.0
<u>Shrubs</u>	0.6	-	1.7	9.1	-	-
<u>Vines</u>	1.2	-	-	-	-	-
<u>Other Types</u>						
Fallen Treetops	-	2.8	-	-	-	-
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

^aThis table is organized similar to the frequency table for continuous data given by Steel and Torrie (1960:12-13).

^bFor each study area, "n" indicates the number of observations.

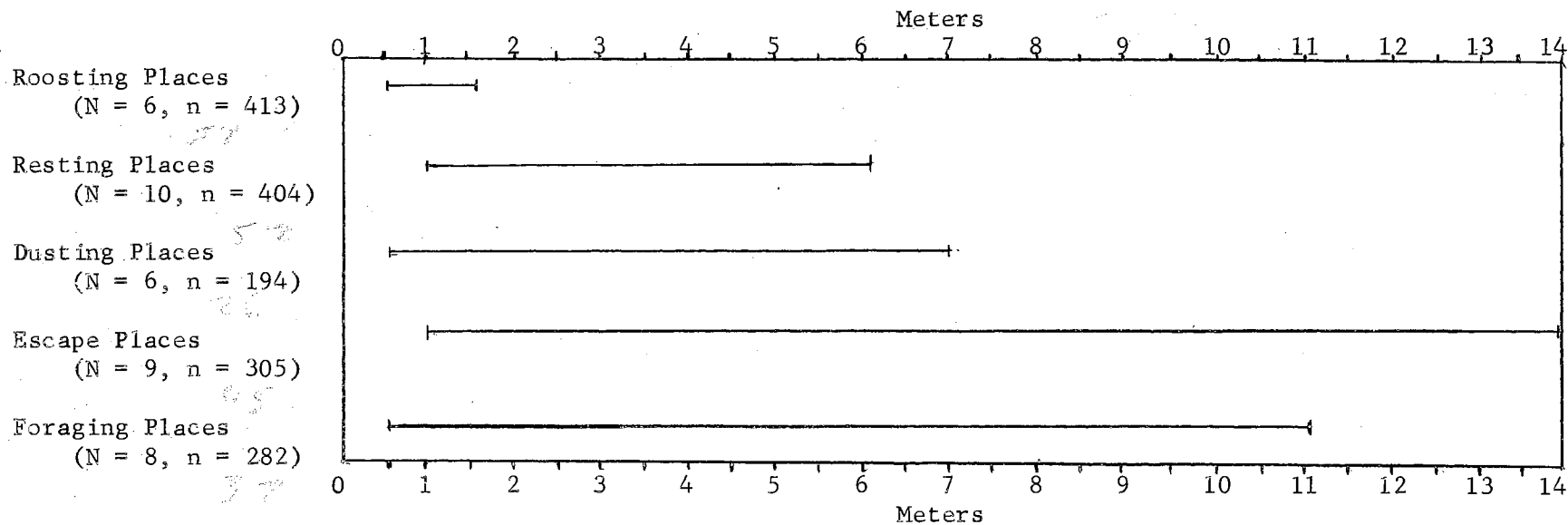


Fig. 2. Height of cover at five kinds of places used by bobwhites. For each kind of place, the horizontal line represents the range of cover heights generally used, "N" represents the number of samples, and "n" indicates the total number of observations. Summarized from Figs. 7, 10, 13, 16, 17, Appendix B.

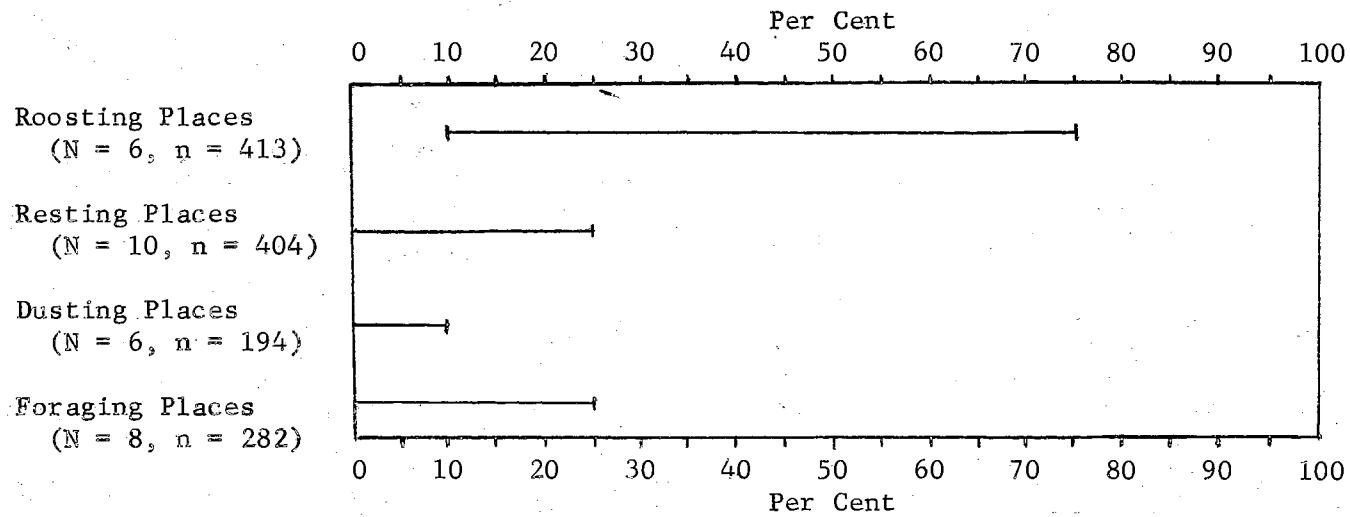


Fig. 3. Per cent density at ground level of cover at four kinds of places used by bobwhites. For each kind of place, the horizontal line represents the range of densities generally used, "N" represents the number of samples, and "n" indicates the total number of observations. Summarized from Figs. 8, 11, 14, 18, Appendix B.

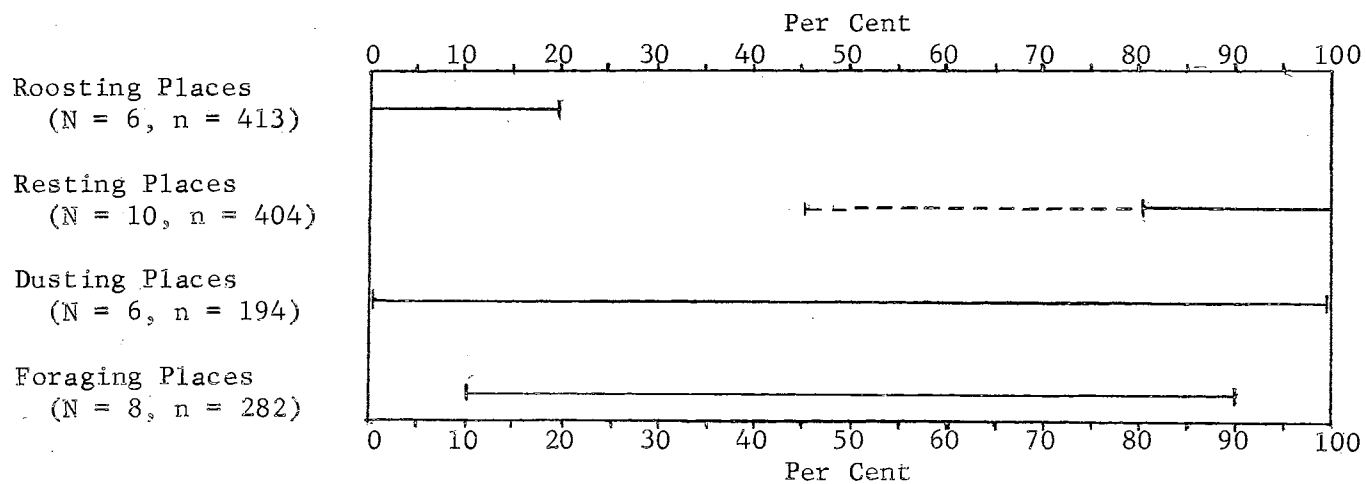


Fig. 4. Per cent overhead concealment provided by cover at four kinds of places used by bobwhites. For each kind of place, the horizontal line represents the range of overhead concealment generally used, "N" represents the number of samples, and "n" indicates the total number of observations. For resting places, the solid portion of the line represents the growing season, while the entire line represents the remainder of the year. Summarized from Figs. 9, 12, 15, 19, Appendix B.

A few roosting places used during periods of snow cover also were observed. These were generally in grassy cover similar to that used at other times. The grassy cover used during one period of particularly severe weather, however, was in the shelter of woodland, and one covey was known to roost in a heap of oak limbs which still retained their leaves.

Units of vegetation used for roosting were of variable size, ranging from fencerows to pastures of a number of acres. The areas that were used consistently, however, exceeded two acres in extent (Table II).

Resting

Cover used for daytime resting was strikingly different from that used for roosting. Resting places were generally under low trees or shrubs which provided considerable overhead concealment, low stem density (Table III, Figs. 2, 3, 4), and lateral concealment.

The lower limit of height of resting cover was about one meter. Lateral concealment was usually provided either by drooping limbs of the same vegetation providing overhead cover, or by erect herbaceous vegetation. Where lateral concealment was incomplete, the birds often huddled against a tree trunk or some other object that provided concealment from at least one direction.

Resting places were often found in areas recognizable as discrete units of vegetational cover. These varied in extent from one tree or shrub to large blocks of woods, and long fencerows and ravines. Units with widths varying to less than two meters were freely used, provided they possessed the characteristics noted above (Table IV).

TABLE II

AREA OF VEGETATIONAL UNITS CONSISTENTLY UTILIZED BY BOBWHITES FOR ROOSTING

<u>Study Area</u>	<u>Description of Vegetational Unit</u>	<u>Size of Vegetational Unit (Acres)</u>	<u>Number of Roosts</u>
Baucom Farm	Unmowed tall grass extending into meadow	2.3	47 in 4 mos.
Baucom Farm	Fallow field, mostly in mat sandbur	3.0	77 in 2.5 mos. (2 coveys)
Bottomland (Main Study Area)	Tall grass area beside Hunt Creek	4.8	54 in 3 mos.
Lawler Farm	Fenced area dominated by tall grasses and forbs	3.1	16 found one day

TABLE III

PER CENT FREQUENCY WITH WHICH CERTAIN ENVIRONMENTAL TYPES PROVIDED COVER AT RESTING PLACES OF BOBWHITES^a

Environmental Types	Main Study Areas						Supplemental Study Areas					
	n = 30 ^b , 60 Baucom Farm		n = 30, 46 Oak Uplands		n = 31, 45 Bottomland		n = 69, 50 Lawler Farm		n = 19, 0 Prairie		n = 24, 0 Bottomland	
Plant Life-Forms	%	%	%	%	%	%	%	%	%	%	%	%
<u>Erect Woody Plants</u>												
Trees	70.0	30.0	66.7	65.2	58.1	55.7	71.0	94.0	84.2	-	33.3	-
Shrubs	26.7	41.7	23.4	15.2	12.9	13.3	5.8	2.0	-	-	33.3	-
Subtotal	96.7	71.7	90.1	80.4	71.0	69.0	76.8	96.0	84.2	-	66.6	-
<u>Erect Herbaceous Plants</u>												
Grasses	-	3.3	3.3	-	16.1	2.2	8.7	-	15.8	-	12.5	-
Forbs	-	1.7	-	2.2	9.7	2.2	4.3	-	-	-	20.9	-
Subtotal	-	5.0	3.3	2.2	25.8	4.4	13.0	-	15.8	-	33.4	-
Vines	-	15.0	3.3	2.2	3.2	13.3	-	-	-	-	-	-
<u>Other Types</u>												
Fallen Trees, etc.	3.3	8.3	3.3	13.0	-	13.3	1.5	-	-	-	-	-
Artifacts	-	-	-	2.2	-	-	8.7	4.0	-	-	-	-
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	-

^aThis table is organized similar to the frequency table for continuous data given by Steel and Torrie (1960:12-13).

^bFor each study area, the left column represents mid-April to mid-November, and the right column represents mid-November to mid-April; "n" indicates the number of observations.

TABLE IV

PER CENT FREQUENCY WITH WHICH COVER AT RESTING PLACES OF BOBWHITES OCCURRED
IN VARIOUS WIDTH CLASSES^a

Width in Meters	Main Study Areas				Supplemental Study Areas					
	n = 30 ^b , 46 Oak Uplands		n = 31, 45 Bottomland		n = 69, 50 Lawler Farm		n = 19, 0 Prairie		n = 24, 0 Bottomland	
	%	%	%	%	%	%	%	%	%	%
0 to 2	3.3	17.4	6.5	42.2	11.6	6.0	5.3	-	-	-
2 to 4	20.0	19.6	9.7	26.7	21.7	50.0	5.3	-	46.7	-
4 to 6	16.8	17.4	19.4	8.9	23.2	32.0	21.0	-	13.3	-
6 to 8	13.3	8.7	12.9	2.2	2.9	10.0	-	-	20.0	-
8 to 10	13.3	13.0	16.1	6.7	2.9	-	26.3	-	13.3	-
over 10	33.3	23.9	35.4	13.3	37.7	2.0	42.1	-	6.7	-
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	-

^aThis table is organized similar to the frequency table for continuous data given by Steel and Torrie (1960:12-13).

^bFor each study area, the left column represents mid-April to mid-November, and the right column represents mid-November to mid-April; "n" indicates the number of observations.

In the case of very small coverts, resting places were necessarily near one or more of the outer edges. In the larger coverts, birds had more choice of resting situation. Mean distances of spots where quail rested from the nearest edge, where covert width was more than six meters, were 4.5, 4.6, 5.7 and 5.9 meters, respectively, in four study situations.

Dusting

Cover requirements of places used for dusting appeared somewhat less restrictive than for roosting and resting places. It was not unusual to find dusting spots in areas without overhead concealment, particularly following rains, when the first places to dry were in the open, exposed to the sun. On the other hand, dusting spots were at times found under canopy typical of resting places (Fig. 4).

The principal characteristic of dusting places was low plant density (Fig. 3). Considerable variation in height and type of vegetation present was tolerated (Fig. 2, Table V).

Bare ground was usually used, but birds sometimes scratched through leaf litter in order to clear a spot for dusting. Dusting spots were scattered in a variety of situations often not recognizable as discrete units of cover.

Escape

Cover where bobwhites took refuge when disturbed was vegetation of at least one meter in height (Fig. 2), and dense enough to hide the birds from the observer. Low trees were used most for this purpose; grasses received some use in all study areas, and grasses and forbs together provided two-thirds of the escape sites observed on the Lawler farm during the growing season (Table VI).

TABLE V

PER CENT FREQUENCY WITH WHICH CERTAIN ENVIRONMENTAL TYPES PROVIDED COVER AT DUSTING PLACES OF BOBWHITES^a

Environmental Types	Main Study Areas			Supplemental Study Areas		
	n = 33 ^b Baucom Farm	n = 39 Oak Uplands	n = 37 Bottomland	n = 36 Lawler Farm	n = 28 Prairie	n = 21 Bottomland
Plant Life-Forms	%	%	%	%	%	%
<u>Erect Woody Plants</u>						
Trees	18.3	59.0	54.1	16.7	71.4	23.8
Shrubs	24.2	10.2	13.5	2.8	3.6	-
Subtotal	42.5	69.2	67.6	19.5	75.0	23.8
<u>Erect Herbaceous Plants</u>						
Grasses	33.3	20.5	21.6	16.7	14.3	42.9
Forbs	24.2	-	8.1	58.3	10.7	33.3
Subtotal	57.5	20.5	29.7	75.0	25.0	76.2
<u>Vines</u>	-	7.7	-	-	-	-
<u>Other Types</u>						
<u>Fallen Trees</u>	-	2.6	2.7	-	-	-
<u>Artifacts</u>	-	-	-	5.5	-	-
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

^aThis table is organized similar to the frequency table for continuous data given by Steel and Torrie (1960:12-13).

^bFor each study area, "n" indicates the number of observations.

TABLE VI

PER CENT FREQUENCY WITH WHICH CERTAIN ENVIRONMENTAL TYPES PROVIDED COVER
AT PLACES USED BY BOBWHITES FOR ESCAPE^a

<u>Environmental Types</u>	<u>Main Study Areas</u>						<u>Supplemental Study Areas</u>					
	n = 25 ^b , 31 Baucom Farm		n = 61, 63 Oak Uplands		n = 35, 30 Bottomland		n = 24, 0 Lawler Farm		n = 19, 0 Prairie		n = 17, 0 Bottomland	
<u>Plant Life-Forms</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
<u>Erect Woody Plants</u>												
Trees	40.0	54.9	83.6	84.1	65.7	56.7	29.2	-	78.9	-	76.4	-
Shrubs	36.0	3.2	6.6	3.2	5.7	-	4.2	-	5.3	-	-	-
Subtotal	76.0	58.1	90.2	87.3	71.4	56.7	33.4	-	84.2	-	76.4	-
<u>Erect Herbaceous Plants</u>												
Grasses	16.0	41.9	9.8	12.7	25.7	43.3	45.8	-	15.8	-	17.7	-
Forbs	8.0	-	-	-	2.9	-	20.8	-	-	-	5.9	-
Subtotal	24.0	41.9	9.8	12.7	28.6	43.3	66.6	-	15.8	-	23.6	-
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	-	100.0	-

^aThis table is organized similar to the frequency table for continuous data given by Steel and Torrie (1960:12-13).

^bFor each study area, the left column represents mid-April to mid-November, and the right column represents mid-November to mid-April; "n" indicates the number of observations.

Overhead concealment was not evaluated at escape sites, since it was usually not possible to determine the exact places where flushed birds alighted. Most escape sites noted were stretches of vegetation not near the lower tolerable limit of area.

Foraging

Cover at places used for foraging was usually erect herbaceous vegetation of low stem density, providing room for unrestricted movement on the ground (Table VII, Fig. 3). Tree and/or shrub growth, also of low stem density, contributed importantly to foraging cover in several instances, particularly on the oak uplands and timbered bottomland during the cool season, when birds were found regularly in sumac clumps and wooded areas.

Height and degree of canopy cover of vegetation in foraging areas was highly variable (Figs. 2, 4), and appeared to impose no limitation upon activities of the birds. Places where birds found sumac seeds, e. g., were often concealed by canopy provided by the sumac plants, whereas areas where they found ragweed were usually without appreciable canopy.

Foods used by bobwhites on the main study areas are summarized below. The data are based on a total of 36 crops, 35 gizzards and 877 droppings, and represent the four seasons, periods of snow cover, and principal foods of very young chicks in summer. Sample size is shown in each table.

Summer Foods: Foods used by very young chicks in summer are shown in Table VIII, and foods taken by older chicks and adults are indicated in Table IX. The chief difference in the two sets of data lies in the

TABLE VII

PER CENT FREQUENCY WITH WHICH CERTAIN ENVIRONMENTAL TYPES PROVIDED COVER
AT PLACES USED BY BOBWHITES FOR FORAGING^a

<u>Environmental Types</u>	<u>Main Study Areas</u>						<u>Supplemental Study Areas</u>			
	n = 24 ^b , 27 Baucom Farm		n = 52, 62 Oak Uplands		n = 29, 41 Bottomland		n = 29, 0 Lawler Farm		n = 18, 0 Bottomland	
<u>Plant Life-Forms</u>	%	%	%	%	%	%	%	%	%	%
<u>Erect Herbaceous Plants</u>										
Grasses	29.2	66.7	42.4	20.9	48.2	34.2	62.1	-	72.2	-
Forbs	29.2	22.2	19.2	8.1	31.0	-	24.1	-	16.7	-
Subtotal	58.4	88.9	61.6	29.0	79.2	34.2	86.2	-	88.9	-
<u>Erect Woody Plants</u>										
Trees	16.6	-	36.5	51.6	10.4	39.0	6.9	-	11.1	-
Shrubs	25.0	11.1	-	19.4	10.4	26.8	6.9	-	-	-
Subtotal	41.6	11.1	36.5	71.0	20.8	65.8	13.8	-	11.1	-
Vines	-	-	1.9	-	-	-	-	-	-	-
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0	-

^aThis table is organized similar to the frequency table for continuous data given by Steel and Torrie (1960:12-13).

^bFor each study area, the left column represents mid-April to mid-November, and the right column represents mid-November to mid-April; "n" indicates the number of observations.

TABLE VIII

FOODS OF BOBWHITE CHICKS ON THE MAIN STUDY AREAS: BASED
ON PER CENT CONTENTS OF 25 DROPPINGS

<u>Food Items</u>	n = 25 ^a	n = 25
	<u>Volume</u>	<u>Occurrence</u>
<u>Seeds & Fruits</u>	<u>%</u>	<u>%</u>
Johnsongrass	18.7	50
Fringeleaf Paspalum	12.5	25
Panicum	7.5	50
Grass, unclassified	2.5	25
White Sweetclover	1.3	25
Sedge, unclassified	1.3	25
Sumac	T	25
Seeds, unclassified	T	25
Subtotal	43.8	-
<u>Animal Material</u>		
Froghoppers	-	25
Leaf Beetles	-	50
Beetles, unclassified	-	75
True Bugs	-	50
Insects, unclassified	-	50
Subtotal	56.2	-
TOTAL	100.0	-

^aThe value of "n" indicates the number of droppings examined.

TABLE IX

SUMMER FOODS OF BOBWHITES ON THE MAIN STUDY AREAS: BASED
ON PER CENT CONTENTS OF 450 DROPPINGS

<u>Food Items</u>	<u>n = 120^a</u>		<u>n = 218</u>		<u>n = 112</u>	
	<u>Baucom Farm</u>		<u>Oak Uplands</u>		<u>Bottomland</u>	
	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>
<u>Seeds & Fruits</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
Johnsongrass	42.0	100	33.5	50	27.0	90
Fringeleaf Paspalum	6.0	80	38.0	90	6.5	90
Wheat	26.5	80	-	-	12.5	20
Panicum	5.5	70	9.0	90	5.5	60
Western Ragweed	-	-	8.0	40	-	-
Silverleaf Nightshade	0.5	50	T	20	8.0	40
Goldenweed	1.0	40	-	-	0.5	20
Sumac	T	30	0.5	50	T	20
Grape	-	-	2.0	40	0.5	10
Violet Woodsorrel Oxalis	T	20	0.5	20	-	-
Croton	-	-	0.5	20	-	-
Sunflower	T	10	-	-	0.5	10
Prostrate Knotweed	T	30	T	10	T	10
Euphorbia	T	20	-	-	T	10
Pink Wildbean	T	10	-	-	-	-
Hairy Crabgrass	T	10	-	-	-	-
Flower-Of-An-Hour	T	10	-	-	-	-
Oak	-	-	T	20	-	-
Coralberry	T	10	-	-	-	-
Blackberry	-	-	T	10	-	-
Slenderlobed Bundleflower	-	-	T	10	-	-
Seeds, unclassified (4 sp)	0.5	30 (4 sp)	2.0	60 (5 sp)	T	40
Subtotal	82.0	-	94.0	-	61.0	-
<u>Green Vegetative Material</u>						
Dicot leaves	T	10	T	10	T	10
Grass leaves	0.5	20	-	-	T	10
Subtotal	0.5	-	T	-	T	-
<u>Animal Material</u>						
True Bugs	-	70	-	70	-	60
Grasshoppers	-	50	-	30	-	60
Leaf Beetles	-	60	-	-	-	50
Ground Beetles	-	40	-	20	-	50
Snout Beetles	-	20	-	20	-	20
Metallic Beetles	-	20	-	-	-	-

TABLE IX (Continued)

<u>Food Items</u>	n = 120 ^a		n = 218		n = 112	
	<u>Baucom Farm</u>		<u>Oak Uplands</u>		<u>Bottomland</u>	
	Vol.	Occur.	Vol.	Occur.	Vol.	Occur.
<u>Animal Material (Continued)</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
Beetles, unclassified	-	30	-	50	-	30
Froghoppers	-	10	-	-	-	10
Ants	-	-	-	10	-	-
Subtotal	17.5	-	6.0	-	39.0	-
TOTAL	100.0	-	100.0	-	100.0	-

^aFor each study area, "n" indicates the number of droppings examined.

noticeably higher proportion of animal material in the diet of the younger chicks. The two age groups used many of the same foods, but in different proportions.

Several notable points are reflected in Table IX. Birds on each of the three main study areas used a variety of foods, but the bulk of the foods used in each case comprised only a very few items. The seeds used in greatest quantity were among the more abundant items present, and conformed generally to the description of "staples" given by Errington (1936).

Summer was a time of relatively stable food use; the major staples were available and utilized practically throughout the period. A few foods, e. g., violet woodsorrel oxalis, were left from spring, but these made up only a small proportion of the summer food.

Green vegetation was found in very small amounts in the droppings. This material was perhaps the most digestible of all the food items identified and may have made up a somewhat greater proportion of the diet than the droppings indicate. Panicum seeds, which provided considerable summer food, are known to yield some green material in the form of the husks which are often taken with the seeds (Handley, 1931).

Fall Foods: A survey of droppings taken in October indicated that food use was in a state of transition from typical summer foods to fall foods. Principal fall foods, representing use during late November and the first three weeks of December, are shown in Table X. Greater variety of food items was present than in summer foods, yet a very few items made up the bulk of the diet.

The items furnishing most of the fall foods were different from the summer staples. Of the eight items listed at the top of Table X,

TABLE X

FALL FOODS OF BOBWHITES ON THE MAIN STUDY AREAS: BASED ON PER CENT CONTENTS OF 10 CROPS, 13 GIZZARDS AND 30 DROPPINGS

<u>Food Items</u>	n = 8 ^a		n = 11		n = 34 ^b	
	<u>Baucom Farm</u>		<u>Oak Uplands</u>		<u>Bottomland</u>	
	Vol.	Occur.	Vol.	Occur.	Vol.	Occur.
<u>Seeds & Fruits</u>	%	%	%	%	%	%
Wheat	37.8	62.5	-	-	2.6	28.6
Western Ragweed	T	75.0	33.8	81.8	2.6	57.1
Grape	0.7	25.0	21.6	72.7	52.7	85.7
Sumac	19.3	87.5	20.2	63.6	23.7	71.4
Trailing Wildbean	19.3	75.0	0.9	18.2	5.3	42.9
Goldenweed	7.5	50.0	-	-	5.3	57.1
Sorghum	8.9	25.0	1.9	18.2	-	-
Coralberry	T	25.0	7.5	27.3	T	14.3
Ash	0.7	12.5	-	-	2.6	57.1
Johnsongrass	0.7	50.0	1.9	36.4	2.6	100.0
Fringeleaf Paspalum	T	37.5	2.4	54.6	T	71.4
Panicum	0.7	12.5	1.9	81.8	-	-
Sunflower	1.5	75.0	-	-	T	42.9
Flower-Of-An-Hour	1.5	50.0	-	-	-	-
Fall Witchgrass	T	37.5	1.4	54.6	T	14.3
Slimflower Scurfpea	-	-	0.9	36.4	-	-
Woollybucket Bumelia	-	-	0.9	9.1	-	-
Hackberry	-	-	0.9	9.1	-	-
Showy Partridgepea	T	37.5	0.5	18.2	T	14.3
Rough Buttonweed	T	37.5	0.5	36.4	-	-
Woolly Croton	T	12.5	T	9.1	T	14.3
Lespedeza	T	37.5	T	18.2	T	42.9
Croton	T	25.0	T	9.1	-	-
Snow-On-The-Mountain						
Euphorbia	T	50.0	-	-	T	14.3
White Crownbeard	-	-	T	18.2	T	42.9
Silverleaf Nightshade	-	-	T	9.1	T	14.3
Hairy Crabgrass	T	25.0	-	-	-	-
Euphorbia	T	12.5	-	-	-	-
Common Witchgrass	-	-	T	9.1	-	-
Eastern Redcedar	-	-	T	18.2	-	-
Prairie Acacia	-	-	-	-	T	14.3
Slenderlobed Bundleflower	-	-	T	9.1	-	-
Florida Paspalum	-	-	-	-	T	28.6
Broadleaf Uniola	-	-	-	-	T	28.6
Pink Wildbean	-	-	-	-	T	14.3
Seeds, unclassified (3 sp)	T	25.0 (2 sp)	0.9	27.3	-	-
Subtotal	98.6	-	98.1	-	97.4	-

TABLE X (Continued)

<u>Food Items</u>	<u>n = 8^a</u>		<u>n = 11</u>		<u>n = 4</u>	
	<u>Baucom Farm</u>		<u>Oak Uplands</u>		<u>Bottomland</u>	
	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>
<u>Greens & Other</u>						
<u>Vegetative Material</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
Wild Lettuce	0.7	12.5	-	-	-	-
Blackseed Plantain	-	-	0.5	27.3	T	25.0
Blackeyesusan	T	12.5	T	27.3	T	25.0
Dicot, unclassified	T	25.0	T	36.4	T	50.0
Violet Woodsorrel Oxalis	-	-	T	9.1	T	50.0
Carolina Geranium	-	-	T	18.2	T	25.0
Iberian Violet	-	-	T	9.1	-	-
Daisy Fleabane	-	-	-	-	T	50.0
Chervil	-	-	-	-	T	25.0
Japanese Brome	-	-	-	-	T	50.0
Green stem material	T	12.5	-	-	-	-
Grass rootstock	-	-	-	-	2.6	75.0
Western Ragweed (dry)	-	-	-	-	T	25.0
Subtotal	0.7	-	0.5	-	2.6	-
<u>Animal Material</u>						
Grasshoppers	-	-	1.4	9.1	-	-
Spider	0.7	12.5	-	-	-	-
True Bugs, unclassified	-	-	T	9.1	T	25.0
Burrower Bugs	T	12.5	-	-	-	-
Leafhoppers	-	-	T	36.4	T	25.0
Beetles, unclassified	-	-	T	9.1	-	-
Ants	T	12.5	-	-	-	-
Spotted Cucumber Beetle	-	-	T	9.1	-	-
Insects, unclassified	T	12.5	T	9.1	T	25.0
Subtotal	0.7	-	1.4	-	T	-
TOTAL	100.0	-	100.0	-	100.0	-

^aFor each study area, "n" indicates the number of crops and/or gizzards examined.

^bFour crop-gizzard samples plus 30 droppings. Only the four crop-gizzard samples were used to evaluate vegetative material and animal material.

only wheat was much used in both summer and fall; the main summer staples had declined greatly in availability by November.

Availability of crop and gizzard contents for fall study greatly facilitated identification of vegetative material. Ten green foods were identified. Insects were taken with considerably less frequency in fall than in summer, and the only spider identified in the entire food collection was found in the fall material.

The bulk of the fall sample from bottomland was provided by crops and gizzards from only two birds, and the large proportions of grape and sumac they contained may not be representative. It is notable, however, that sumac was important also in the other study areas, where samples were larger.

Winter Foods: Principal winter foods are presented in Table XI. The data were taken in late December and the first half of January, but may be representative of much of the winter period, as groups of birds were commonly observed foraging over much the same ground later in the winter.

Reliance on a few staples is plainly evident in Table XI. In spite of great variety in numbers of different items consumed, practically the entire volume of foods was made up of only six items, namely: sumac, trailing wildbean, cultivated sorghum from livestock feces, wild grape, coralberry and leaves of wild lettuce.

All the above species except sorghum occurred on the study areas in relatively large amounts and in some degree of concentration. Sorghum availability depended upon where the cattle happened to be that defecated these seeds. When available, their feces provided sorghum in such quantity that the birds could fill up readily. Sumac

TABLE XI

WINTER FOODS OF BOEWHTES ON THE MAIN STUDY AREAS: BASED ON
PER CENT CONTENTS OF 26 CROPS AND 22 GIZZARDS

Food Items	n = 25 ^a		n = 19		n = 4	
	Baucom Farm		Oak Uplands		Bottomland	
	Vol.	Occur.	Vol.	Occur.	Vol.	Occur.
<u>Seeds & Fruits</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
Sumac	10.0	56.0	63.4	89.5	63.6	100.0
Trailing Wildbean	82.5	100.0	2.7	26.3	6.1	25.0
Sorghum	-	-	12.8	21.1	3.0	25.0
Grape	1.9	32.0	0.2	10.5	27.3	50.0
Coralberry	0.6	24.0	2.7	36.8	-	-
Hairy Crabgrass	2.6	72.0	-	-	-	-
Goldenweed	0.2	36.0	1.6	21.1	T	25.0
Western Ragweed	T	4.0	0.4	47.4	-	-
Fringeleaf Paspalum	0.4	36.0	0.2	15.8	-	-
Fall Panicum	0.4	24.0	-	-	-	-
White Crownbeard	0.4	8.0	0.2	5.3	T	25.0
Sunflower	0.2	24.0	T	10.5	-	-
Common Witchgrass	0.2	16.0	-	-	-	-
Croton	0.2	16.0	T	5.3	-	-
Illinois Bundleflower	0.2	8.0	-	-	-	-
Snow-On-The-Mountain						
Euphorbia	T	8.0	0.2	10.5	-	-
Wheat	-	-	0.2	5.3	-	-
Rough Buttonweed	-	-	0.2	10.5	-	-
Woolly Croton	0.2	12.0	0.2	5.3	-	-
Eastern Redcedar	T	4.0	T	5.3	T	50.0
Slimleaf Panicum	T	4.0	T	15.8	-	-
Prostrate Knotweed	T	44.0	T	5.3	-	-
Showy Partridgepea	T	20.0	-	-	T	25.0
Prairie Acacia	T	4.0	-	-	T	25.0
Switchgrass	T	4.0	-	-	-	-
Johnsongrass	T	20.0	-	-	-	-
Euphorbia	T	28.0	-	-	-	-
Sweetclover	T	8.0	-	-	-	-
Sedge, unclassified	T	4.0	-	-	-	-
Broadleaf Uniola	T	4.0	-	-	-	-
Eastern Redbud	-	-	-	-	-	25.0
Flower-Of-An-Hour	-	-	T	5.3	-	-
Fall Witchgrass	-	-	T	5.3	-	-
Japanese Brome	-	-	T	5.3	-	-
Pink Wildbean	-	-	T	5.3	-	-
American Bittersweet	-	-	-	-	T	25.0
Seeds, unclassified (2 sp)	T	4.0 (1 sp)	T	5.3	-	-
Subtotal	100.0	-	85.0	-	100.0	-

TABLE XI (Continued)

<u>Food Items</u>	n = 25 ^a		n = 19		n = 4	
	<u>Baucom Farm</u>		<u>Oak Uplands</u>		<u>Bottomland</u>	
	Vol.	Occur.	Vol.	Occur.	Vol.	Occur.
<u>Greens & Other</u>						
<u>Vegetative Material</u>	%	%	%	%	%	%
Lettuce	-	-	11.6	21.1	-	-
Chervil	T	4.0	2.0	15.8	T	50.0
Violet Woodsorrel Oxalis	T	4.0	1.0	26.3	T	25.0
Blackeyesusan	T	8.0	T	5.3	-	-
Daisy Fleabane	T	12.0	T	15.8	T	25.0
Carolina Geranium	T	8.0	T	10.5	-	-
Japanese Brome	T	4.0	T	5.3	-	-
Blackseed Plantain	T	4.0	T	5.3	T	25.0
Iberian Violet	T	4.0	T	5.3	-	-
Western Yarrow	-	-	T	10.5	-	-
Louisiana Sagebrush	-	-	T	5.3	-	-
Heath Aster	-	-	T	5.3	-	-
Grass-like stems	-	-	0.4	21.1	-	-
Bud	T	4.0	-	-	-	-
Unclassified	T	28.0	T	26.3	T	25.0
Subtotal	T	-	15.0	-	T	-
<u>Animal Material</u>						
Beetles, unclassified	T	8.0	T	5.3	-	-
True Bugs	T	4.0	T	5.3	-	-
Immature Insect	-	-	T	5.3	-	-
Unclassified	-	-	T	5.3	-	-
Subtotal	T	-	T	-	-	-
TOTAL	100.0	-	100.0	-	100.0	-

^aFor each study area, "n" indicates the number of crops and/or gizzards examined.

use was even greater than in fall. Trailing wildbean perhaps furnishes a good source of fall food, but was not used in large amounts by birds under observation until winter, when a covey on the Baucom farm moved to the vicinity of a fallow field where beans were abundant. Availability of ragweed and goldenweed, important fall foods, decreased greatly by winter, and these made up a very small part of the winter diet.

Only two crops and two gizzards were available from the bottomland, and the high proportions of sumac and grape contained in them may not be representative. It is notable, however, that sumac was as highly represented in another study area, from which the sample was almost five times as large. Grape was prominent also in the fall sample.

Seeds of hairy crabgrass and prostrate knotweed made up very small proportions of the volume of winter foods on the Baucom farm, yet occurred in the food samples with noticeable frequency, 72 and 44 per cent, respectively. These are very small seeds which were present in the same field where the birds fed daily on trailing wildbean. The birds consumed mostly wildbean but almost always picked up some crabgrass and knotweed seeds in the process.

Items of green vegetation identified included all those known from the fall material, plus several others. Animal material occurred in less quantity than in preceding seasons.

Foods Used During Periods of Snow Cover: Foods identified from droppings taken during periods of snow cover are listed in Table XII. The variety of foods taken during these periods was considerably less than that during fall and early winter. Sumac seeds were the main food, as in early winter, but now made up an even greater proportion of the total. The major foods, namely sumac, trailing wildbean, wild grape,

TABLE XII

FOODS OF BOBWHITES DURING PERIODS OF SNOW COVER ON THE MAIN
STUDY AREAS: BASED ON PER CENT CONTENTS OF 229 DROPPINGS

<u>Food Items</u>	<u>n = 30^a</u>		<u>n = 100</u>		<u>n = 99</u>	
	<u>Baucom Farm</u>		<u>Oak Uplands</u>		<u>Bottomland</u>	
	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>
<u>Seeds & Fruits</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
Sumac	75.0	100.0	90.6	100.0	66.0	100.0
Trailing Wildbean	15.0	100.0	-	-	-	-
Grape	10.0	100.0	T	20.0	1.0	40.0
Fall Witchgrass	T	100.0	-	-	1.0	20.0
Slimleaf Scurfpea	-	-	0.4	40.0	-	-
Lespedeza	-	-	1.4	60.0	-	-
Panicum	-	-	T	60.0	-	-
Coralberry	-	-	7.0	40.0	3.0	40.0
Rough Buttonweed	-	-	T	40.0	-	-
Fringeleaf Paspalum	-	-	-	-	4.0	80.0
Western Ragweed	-	-	-	-	2.0	60.0
Johnsongrass	-	-	-	-	1.0	20.0
Sorghum	-	-	-	-	1.0	20.0
Goldenweed	-	-	-	-	10.0	60.0
Blackberry	-	-	-	-	T	20.0
Showy Partridgepea	-	-	-	-	T	20.0
Sunflower	-	-	-	-	T	20.0
Croton	-	-	-	-	T	20.0
Seeds, unclassified	-	-	(3 sp) 0.6	60.0 (1 sp)	T	20.0
<u>Subtotal</u>	<u>100.0</u>	<u>-</u>	<u>100.0</u>	<u>-</u>	<u>89.0</u>	<u>-</u>
<u>Greens & Other</u>						
<u>Vegetative Material</u>						
Japanese Brome	-	-	-	-	T	40.0
Blackseed Plantain	-	-	-	-	T	20.0
Carolina Geranium	-	-	-	-	T	20.0
Greens, unclassified	-	-	T	60.0	1.0	40.0
Fibrous stem material	-	-	-	-	10.0	20.0
<u>Subtotal</u>	<u>-</u>	<u>-</u>	<u>T</u>	<u>-</u>	<u>11.0</u>	<u>-</u>
<u>Animal Material</u>						
Froghoppers	-	-	-	-	T	20.0
Insects, unclassified	-	-	-	-	T	20.0
<u>Subtotal</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>T</u>	<u>-</u>
<u>TOTAL</u>	<u>100.0</u>	<u>-</u>	<u>100.0</u>	<u>-</u>	<u>100.0</u>	<u>-</u>

^aFor each study area, "n" indicates the number of droppings examined.

coralberry and goldenweed, were plants that occurred in concentrated stands, and two of these, sumac and coralberry, were available above snow cover.

The most critical period of the winter of 1961-62 occurred between December 8 and January 24, when snow cover was present 19 out of 48 days, with one week of continuous cover. Bobwhites came readily to traps baited with sorghum placed in sumac clumps and several were captured and weighed repeatedly.

Table XIII shows weight losses of the eight birds that were weighed twice or more during this time. Table XIV shows weight gained by the 12 birds which were trapped during the critical period and again shortly afterwards. This loss and gain coincides strikingly with the occurrence and absence of snow cover and the more restricted diet related to the period of snow cover.

Spring Foods: Foods identified from droppings taken during spring are shown in Table XV. This was a period of rapidly changing food use. The considerable use of foods left from previous seasons, and the very minor use of insects, both typical of winter, lasted until April. During this month sedges, violet woodsorrel oxalis, bedstraw and American elm fruits were taken in quantity. Green dicot leaves received considerable use in April and May, and use of insects increased markedly in May.

The foods typical of this season faded rather quickly, and by late May the diet began changing to grass seeds, which were the main foods until fall. In Table XV grass seeds appear as practically the entire spring diet of birds on the Baucom farm. This is because the only samples of spring foods available from this area were taken in the latter part of the season.

TABLE XIII

WEIGHT LOSSES OF BOBWHITES ON THE MAIN STUDY AREAS DURING
PERIODS OF SNOW COVER, WINTER OF 1961-62

Band No.	Period Between Captures	No. Days of Snow Cover	Weight	Weight Lost
			Lost	Per Day of Snow Cover
			<u>gm</u>	<u>gm</u>
411401	Dec. 1-Jan. 22	18	42	2.33
411402	Jan. 3-Jan. 23	13	40	3.03
411404	Dec. 2-Jan. 22	18	13	0.72
411408	Jan. 6-Jan. 22	12	24	2.00
411412	Dec. 18-Jan. 22	12	50	4.17
411413	Dec. 17-Jan. 23	13	45	3.46
411414	Dec. 20-Jan. 22	12	44	3.67
411417	Jan. 6-Jan. 25	13	24	1.85
Average:				2.66

TABLE XIV

WEIGHT GAINS OF BOBWHITES ON THE MAIN STUDY AREAS FOLLOWING
PERIODS OF SNOW COVER, WINTER OF 1961-62

Band No.	Period Between Captures	No. Days With- out Snow Cover	Weight	Gain Per Day
			Gained	Without Snow
			<u>gm</u>	<u>gm</u>
411401	Jan. 22-Jan. 26	2	7	3.50
411402	Jan. 23-Feb. 21	28	7	0.25
411404	Jan. 22-Jan. 26	2	8	4.00
411408	Jan. 22-Jan. 26	2	7	3.50
411412	Jan. 22-Jan. 26	2	3	1.50
411414	Jan. 22-Jan. 26	2	13	6.50
411417	Jan. 25-Feb. 21	28	2	0.07
411423	Jan. 24-Jan. 26	2	6	3.00
411426	Jan. 22-Jan. 26	2	5	2.50
411425	Jan. 24-Feb. 21	28	23	0.82
411430	Jan. 23-Jan. 26	2	0	-
411429	Jan. 23-Feb. 21	28	12	0.43
Average:				2.17

TABLE XV

SPRING FOODS OF BOBWHITES ON THE MAIN STUDY AREAS: BASED ON
PER CENT CONTENTS OF 173 DROPPINGS

<u>Food Items</u>	<u>n = 13^a</u>		<u>n = 80</u>		<u>n = 80</u>	
	<u>Baucom Farm</u>	<u>Oak Uplands</u>	<u>Oak Uplands</u>	<u>Bottomland</u>	<u>Bottomland</u>	<u>Bottomland</u>
	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>	<u>Vol.</u>	<u>Occur.</u>
<u>Seeds & Fruits</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
Panicum	78.3	100.0	21.6	46.2	20.4	33.3
American Elm (fruits)	-	-	-	-	19.5	22.2
Fringeleaf Paspalum	8.3	100.0	2.3	15.4	8.9	22.2
Sumac	-	-	7.7	15.4	4.4	33.3
Sorghum	-	-	7.3	7.7	0.6	11.1
Sedge, unclassified	-	-	15.4	23.1	T	22.2
Wheat	-	-	7.3	7.7	-	-
Bedstraw	-	-	1.5	30.8	5.6	55.5
Violet Woodsorrel Oxalis	1.7	66.6	2.3	7.7	1.7	44.4
Japanese Brome	1.7	33.3	-	-	-	-
Blackberry	T	33.3	-	-	T	11.1
Western Ragweed	-	-	T	7.7	-	-
Coralberry	-	-	T	7.7	T	11.1
Seeds, unclassified	-	-	-	- (3 sp)	4.4	44.4
Subtotal	90.0	-	65.4	-	65.5	-
<u>Greens & Other</u>						
<u>Vegetative Material</u>						
Dicot leaves	-	-	7.7	23.1	16.7	77.7
Rootstock	-	-	-	-	0.6	11.1
Fibrous material	-	-	0.4	7.7	-	-
Japanese Brome	-	-	T	7.7	-	-
Unclassified	-	-	-	-	1.1	11.1
Subtotal	-	-	8.1	-	18.4	-
<u>Animal Material</u>						
True Bugs (partly stinkbugs)-	-	66.6	-	15.4	-	66.6
Ground Beetles	-	66.6	-	15.4	-	22.2
Leaf Beetles	-	33.3	-	53.8	-	55.5
Beetles, unclassified	-	33.3	-	15.4	-	33.3
Grasshoppers	-	33.3	-	15.4	-	33.3
Froghoppers	-	33.3	-	7.7	-	22.2
Metallic Beetles	-	33.3	-	15.4	-	22.2
Snout Beetles	-	-	-	30.8	-	-
Ants	-	-	-	7.7	-	-
Immature Insects	-	-	-	7.7	-	-
Insects, unclassified	-	-	-	23.1	-	33.3
Subtotal	10.0	-	26.5	-	16.1	-
TOTAL	100.0	-	100.0	-	100.0	-

^aFor each study area, "n" indicates the number of droppings examined.

The variety of total spring foods used was almost as great as that of summer foods. Food use during any month in spring, however, was more restricted than for a similar period in summer. Each spring month had its own group of staple foods, while a relatively stable but larger number of foods was available through the summer.

Summary of Food Use: As expected, the pattern of food use was seasonal. Summer was a period of relatively stable food use, with major staples present practically throughout the season. The fall staples were largely different from these. The items comprising the bulk of the winter foods were seeds that had been present in quantity for several months, receiving increasing use as the seasons progressed.

The variety of foods taken during periods of snow cover was somewhat less than at other times. Sumac seeds were taken in quantity, as in early winter, but now made up an even greater proportion of the diet. Sumac and coralberry fruits were available on the plant, above snow cover. Bobwhites lost weight on this restricted diet composed mainly of hard seeds.

Spring was a period of rapidly-changing food use. The use of foods left from previous seasons lasted until April, when a new crop of early seeds and fruits became available. By late May the diet had begun changing to grass seeds, which were the main foods until fall.

Birds on the main study areas used considerable variety in food material during each season, but at the same time most of the volume was made up of a very few items. This was particularly true in winter.

Foods taken in greatest quantity were generally larger than two millimeters in greatest dimension. They were usually abundant, and persisted for relatively long periods of time. Sumac fruits met

these specifications, but were largely ignored until fall. They were taken with increasing frequency as other presumably more palatable species became less available. Use of coralberry seeds followed a similar pattern, but these were never heavily utilized.

Whistling

Trees provided most of the whistling sites used by male bobwhites during the breeding season (Table XVI). Total height of vegetation at

TABLE XVI

PER CENT FREQUENCY WITH WHICH CERTAIN ENVIRONMENTAL TYPES PROVIDED COVER AT WHISTLING SITES OF MALE BOBWHITES ON THE MAIN STUDY AREAS

Environmental Types	n = 31 Frequency
<u>Plant Life-Forms</u>	<u>%</u>
Trees	90.3
Shrubs	6.5
Grasses	3.2
TOTAL	100.0

these places was generally between 3.5 and 7.5 meters, but perches used were usually not more than two meters above ground (Fig. 5). Overhead concealment generally exceeded 80 per cent (Fig. 6). Isolated trees or groups of only two or three trees served as whistling places in 18 per cent of the observations.

Several whistling locations observed in an area of scant tree growth adjacent to the Oklahoma State University campus differed from those observed on the main study areas and reported in Figs. 5 and 6.

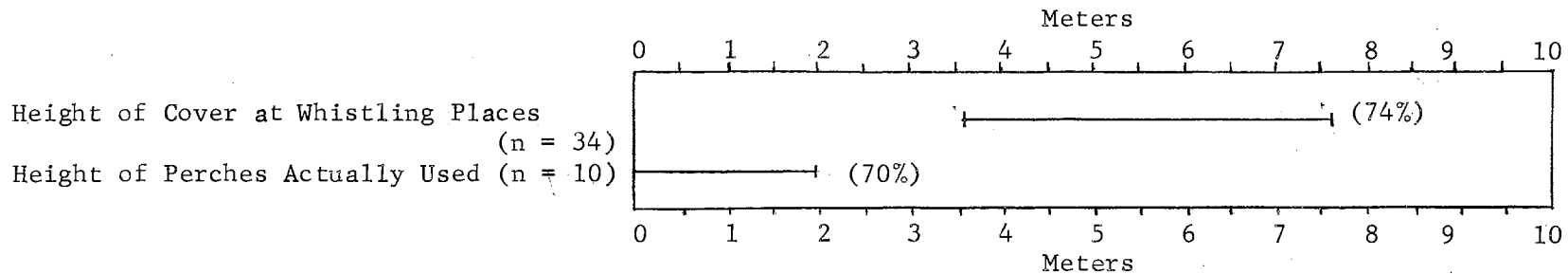


Fig. 5. Height of cover at whistling places of male bobwhites, and height of perches actually used. In each case, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

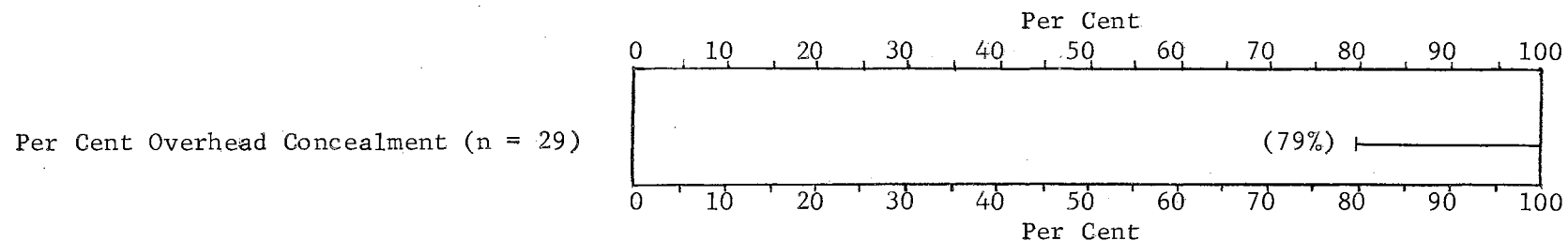


Fig. 6. Per cent overhead concealment provided by cover at whistling places of male bobwhites. The horizontal line represents the range within which 79 per cent of the observations occurred, based on a total of 29 observations.

In this area whistling perches included fenceposts, a dead standing tree, and a log, all of which lacked overhead concealment. Since these sites were in the open, measurements of density and area of cover were impossible.

CHAPTER V

DISCUSSION

Habitat Components

Data from the present study and from the literature are here compared in order to arrive at common denominators, i. e., habitat characteristics that are applicable to widely separated areas of different floristic composition. These characteristics are summarized in Table XVII, and are discussed in following sections. The numerical data in the table were taken from the results section of this paper except as noted; information on plant life-forms was taken from this study and from literature cited in the following sections. Lateral concealment was generally present at the several kinds of places mentioned.

Roosting

Comparison of data from this study with those reported by Klimstra and Ziccardi (1963) provides a basis for characterizing vegetation used by bobwhites for roosting cover in different parts of their geographic range. Roosting sites are typically located on the ground, surrounded by herbaceous vegetation 0.3 meter or more in height, of low to moderately high density, and offering little or no overhead canopy or obstruction. This is in agreement with general statements of Stoddard (1931:53-54) and of Robinson (1957:69) regarding lack of overhead

TABLE XVII

CHARACTERISTICS OF COVER AT PLACES USED BY BOBWHITES IN VARIOUS GEOGRAPHIC AREAS

Kind of Place	Height in Meters	Per Cent Density	Per Cent Overhead Concealment	Plant Life-Forms Most Used
Roosting ^a	0.3-1.5	10-75	0-20	Grasses, Forbs, Low Woody Plants
Resting	At Least 1.0	0-25	(45) 80-100	Trees, Shrubs, Vines
Dusting	At Least 0.5	0-10	Not Limiting	Trees, Shrubs, Grasses, Forbs, Vines
Foraging ^b	Not Limiting	0-25	Not Limiting	Grasses, Trees, Forbs, Shrubs
Escape ^c	At Least 1.0	At Least Moderately Dense	Not Limiting	Shrubs, Vines, Trees, Grasses, Forbs
Whistling ^d	Not Limiting	Not Limiting	Not Limiting	Trees, Shrubs

^aLower limit of height is from Klimstra and Ziccardi (1963:207).

^bComments on height and concealment are from general observations made in this study, in accord with Handley (1931:115, 117).

^cNotes on concealment are from Leopold (1931:70). Information on density is from Errington and Hamerstrom (1936:383-392).

^dNotes on height and density are from general observations made in this study, in accord with Stoddard (1931:102).

canopy, and with the following regarding plant life-forms: Errington and Hamerstrom, 1936:386; Lay, 1940:32; Lehmann, 1939:3; Wilson and Vaughn, 1944:101. Grasses are used more often than forbs. Vines and erect woody plants may be used, provided they are of rather short and open growth (Stoddard, 1931:53-54).

The particular plant taxa that provide the above vegetational growth types may vary between different geographic areas. Of the 34 plants used by bobwhites in the present study and the 30 reported by Klimstra and Ziccardi (1963:209), only seven were common to both studies, and none were highly utilized in both instances.

Resting

Results of this study and others indicate that cover at places used by bobwhites for resting is usually low woody growth providing overhead canopy and lateral concealment, but low stem density. While mensurational data from other localities were not found in the literature, several investigators have given descriptions of resting or loafing places in which they mention or imply the use of vegetation providing overhead canopy for resting (Latham and Studholme, 1952:21; Lehmann, 1939:4; Leopold, 1933:308).

Trees, shrubs and vines are the plant life-forms most often used for resting cover (Bushong, 1959:3; Lehmann, 1939:3; Lehmann and Ward, 1941:133; Robinson, 1957:51; Stoddard, 1931:45; Wilson and Vaughn, 1944:101, 103; present study). Other plant life-forms may be used when they possess the appropriate combinations of height, canopy and density (Stoddard and Handley, 1931:380; Table III of this report).

The importance of particular plant species to bobwhites in general for resting cover may be dismissed on the basis of the present study,

since the important species providing resting cover were not the same in all study areas (Appendix B).

Dusting

The main requirement for a suitable dusting place seems to be an area of low plant density with a dry, friable ground surface. Present data support the few statements found in the literature that relate to concealment of dusting spots. These indicate that bobwhites will dust either under canopy or in the open (Lay, 1940:31; Stanford, 1952:9; Stoddard, 1931:56). This study revealed also that considerable variation in height of vegetation present is tolerated.

Since places with overhead canopy, as well as places without canopy, are used; and since considerable variation in height of vegetation is tolerated, the types of growth providing all these variations are employed for cover when dusting. For example, stands of trees or shrubs or forbs or grasses may be used freely, either individually or collectively. Logs and certain artifacts also are used at times.

Escape

Wildlife ecologists generally agree that escape or refuge cover is essential to the welfare of a population of bobwhites (Stoddard, 1961:255; Errington and Hamerstrom, 1936:383). Indeed, many management publications discuss escape cover to the near exclusion of cover for other uses. In spite of the considerable discussion devoted to this subject, mensurational data are generally lacking in the literature.

This study showed that cover used for escape is usually vegetation at least one meter in height and of sufficient density to provide concealment. Shrubs, trees and vines are the plant life-forms that most

often meet these specifications, while fallen tree tops, brush piles, forbs and tall grasses are suitable in some instances. This is in agreement with the following: Errington and Hamerstrom, 1936:391; Lehmann and Ward, 1941:133; Parmalee, 1953:769; Reeves, 1957:133-134; Scott and Klimstra, 1954:8; Stanford, 1952:60, 66, 68; Stoddard, 1931:406 and 1939:169; Stoddard and Handley, 1931:363, 368.

Foraging

Cover: This study indicated that the main requirement of cover for use when foraging is plant growth open enough to permit unrestricted movement on the ground. This is in agreement with Handley, 1931:116; Stoddard, 1931:406; and Stoddard and Handley, 1931:364. In this study, bobwhites foraged in the open, among herbaceous plants, as well as under canopy provided by woody plants. Considerable variation in height of cover in foraging areas existed.

Foods Used: Bobwhite foods identified in the present study include a number already reported from Oklahoma (Baumgartner, 1946; Baumgartner, et al., 1952; Bird and Bird, 1931; Davison, 1935; Hanson, 1957; Lee, 1948; Morris, 1957; Ortenburger and Little, 1930; Tate, 1925; Wagner, 1949).

Relative proportions of various taxa used as food vary considerably between different regions of the state and between vegetation types, even within as small an area as Payne County (Baumgartner, 1946; Baumgartner, et al., 1952; Bird and Bird, 1931; Hanson, 1957; Lee, 1948; Morris, 1957; present study). A similar variation occurs between seasons, in a given locale (Baumgartner, 1946; Lee, 1948; present study).

Of the studies previously conducted in the state, only the fall-winter investigation of Baumgartner (1946) was similar in scope and location to any part of the present study. Several food items occurred in presumably important amounts in both groups of data. Differences in proportions of these items reported from the two studies might be due either to ecological circumstances or to differences in sampling. While the two investigations differ some in particular plant taxa and relative proportions thereof reported, they agree closely on proportions of major classes of foods used (Table XVIII).

It appears from studies conducted that a number of major bobwhite foods of Payne County, as well as of the state as a whole, have been identified. The question remains as to what basically composes the food resource of the species over its entire range. As for the taxa of foods taken, the list is lengthy, as shown by this study and others cited, and by data from other states. The foods used, however, may be classified into a few main categories which have applicability across the bobwhite's range (Table XVIII). In the table, differences in values from various geographic areas representing a given season generally are not great. This basic trend is evident: Use of seeds and fruits is paramount in all seasons, with some decrease during the warmer months, when animal material, mostly insect, is much used; use of vegetative material is generally the lowest, except that in winter it exceeds the use of animal material.

Data in this report, as well as those of Baumgartner, et al., (1952:347) suggest that only a very few staples are necessary in a given season. Davison (1942:102) suggests that two may be sufficient. Errington (1936:357) reports that experimentally-confined bobwhites

TABLE XVIII.

PER CENT VOLUME OF MAJOR CLASSES OF FOODS USED BY BOBWHITES IN VARIOUS GEOGRAPHIC AREAS

Seasons	Seeds and Fruits				Vegetative Material				Animal Material (mostly insects)			
	1 ^a	2 ^b	3 ^c	4 ^d	1	2	3	4	1	2	3	4
	%	%	%	%	%	%	%	%	%	%	%	%
Spring	73.7	-	78.0	-	8.8	-	4.0	-	17.5	-	18.0	-
Summer	79.0	-	79.5	61.5	0.2	-	0.9	6.5 ^e	20.8	-	19.6	32.0
Fall	98.0	97.5	81.7	92.6	1.3	0.8	0.9	1.0	0.7	1.7	17.4	6.4
Winter	95.0	95.4	84.0	88.4	5.0	4.3	13.3	10.1	T	0.3	2.7	1.5
Snow Cover	96.3	-	-	-	3.7	-	-	-	T	-	-	-
AVERAGE	88.4	-	80.8	-	3.8	-	4.8	-	7.8	-	14.4	-

^aPayne County, Oklahoma (the present study).

^bPayne County, Oklahoma (Baumgartner, 1946).

^cGeorgia and southeastern United States (Handley, 1931).

^dAlabama (Allen and Pearson, 1945; Gray, 1938).

^eProbably includes some seed material.

have subsisted entire winters exclusively on corn.

Habitat Selection

This section discusses the possible significance of the selection of particular vegetational characteristics by bobwhites for various uses.

Concealment

In this study bobwhites preferred concealed places for their activities. This is in agreement with Stoddard (1931) and with Handley (1931). Foraging and dusting were carried on in the open at times, but usually close to escape cover. Whistling males will use exposed perches, but present data suggest a preference for perches offering some degree of concealment.

The use of resting places under canopy provides protection from direct exposure to the sun in summer. It is noteworthy, however, that in this study bobwhites rested under canopy in winter as well, even on days when air temperature was quite low. This suggests concealment as a basic reason for use of resting places that are sheltered by canopy.

Density of Vegetation at Ground Level

Bobwhites generally use areas of low stem density since such areas provide room for unrestricted movement on the ground. This applies particularly to places used for dusting, foraging, and resting. Roosting spots are open enough for birds to squat together on the ground, but surrounding vegetation may be quite dense. This hindrance to movement may be overcome by flying to the roost, as was observed on several occasions in this study. Stoddard (1931:45, 54), however, reports that in the southeast bobwhites roost in less dense cover, and that they

generally walk to their roost.

Foods Used

The fact that the taxa of food items taken by bobwhites may vary considerably from one area to another, as well as from season to season in a given locale, indicates a broad adaptability on the part of the species. This is one possible reason for its wide distribution. Adaptability not only permits the species to occupy various geographic areas with different associations of plant taxa (but not of life-forms), but also allows local populations some leeway in adjusting to changing food conditions that result from plant phenology, changing land use, plant succession, or failure of some plants to set seeds in certain years.

While bobwhite foods at large may be classified into a few broad categories reflecting the basic nature of the species' food habits, a knowledge of local or regional food resources requires identification of items used.

Interspersion of Vegetation Types

The habitat of the bobwhite has been characterized in preceding sections as generally comprising units of woody, canopy-forming vegetation closely interspersed with units of erect, open herbaceous vegetation. Bobwhites use each type where they have ready access to the other type and to a food source. This represents the "simultaneous access" of Leopold (1933). At night birds roost near daytime foraging grounds, which in turn are located near woody cover for midday resting and for escape. Dusting can usually be carried on in either of the two types.

In this study, where the two above types did not occur closely interspersed, bobwhites were usually absent. Use of relatively extensive

units of either of the two types was generally restricted to portions that were adjacent to the other type. Examples are given below.

The area of tall grass west and north of the Baucom farm study area (Fig. 1) was generally not frequented by bobwhites. Much of the vegetation of this area was suitable for roosting, but only a small portion adjacent to the wooded area in the upper left of the figure was used for this purpose. The remainder, which extended some distance to the west, beyond the limits of the map, was largely a gap in the local distribution of bobwhites. It lacked any concentrated food source, and woody cover was scant.

Much of the grassland north of State Highway 51 was of similar disposition. While a few small stands of food plants were present, most of the area was of limited use except for roosting. Small sections were used for this purpose, but such use occurred only adjacent to the woodland. When one considers that an area as small as the block of tall grass extending into the north end of the meadow is adequate as a roosting ground for a covey, the superfluous nature of the larger expanses of grassland may be appreciated.

In the more extensive stretches of oak woodland north of the highway, cover suitable for resting, dusting and escape was abundant. Herbaceous roosting cover, however, was not plentiful, and the food supply was generally scattered. In all this area only two coveys were present.

During the preliminary stages of the project, when study areas were being selected, relatively large units of grassland and of oak woodland were cruised in search of bobwhites. Invariably birds were found only in areas where blocks of woody and herbaceous vegetation

were present in close interspersion.

Bobwhite Habitat and the Plant Life-Form Concept

During this study, cover used for various purposes was classified according to the life-form system of Du Rietz (1931). This yielded insight into the phenomenon of habitat selection, particularly the broad question of places used at night vs. places used by day.

Herbaceous vegetation is generally favored for roosting, while woody vegetation is freely used for concealment during the day. Herbaceous vegetation generally offers little overhead obstruction, and is generally pliable, and therefore presents a minimum of interference with sudden flight of birds disturbed in the dark. The use of herbaceous vegetation for roosting therefore may have survival value.

The presence of stiff, woody vegetation does not offer the same hazard to flying birds in daytime when visibility is usually good, hence the presence of woody growth can be tolerated in daytime in order to obtain use of the superior cover that it affords.

Although cover used showed some conformity to the pre-selected categories of plant life-forms employed, as indicated above, the habitat of the bobwhite is more completely characterized when measurement data are considered as well. The attributes of life-form, height, density and canopy, when taken together, appear to characterize adequately the particular cover types used by bobwhites.

Identity and Description of Bobwhite Habitat

The habitat of the bobwhite is here considered to comprise suitable food items (Table XVIII) and closely interspersed units of cover suitable

for roosting, resting, dusting, escape and foraging (Table XIX), all located within the daily cruising radius of the species. This varies generally up to about 400 yards (Leopold, 1933:75-77, 281).

The habitat is characterized by small units of low woody vegetation providing overhead canopy, lateral concealment and low stem density, closely interspersed with erect herbaceous vegetation with little or no overhead canopy and of varying density.

In addition to the above vegetation types, breeding season habitat includes whistling sites for males, described in the preceding section, and nesting and brooding cover, which may differ from that described above.

Management Suggestions

On the basis of the findings reported here, steps to be followed in a land management program directed at increasing numbers of bobwhites on a given tract of land are outlined below. A comprehensive test of this method should follow.

Evaluation

1. Compare vegetation of the area, during the growing season and again in winter, with characteristics of the cover components of habitat given in previous sections (see particularly Table XIX).
2. Map location and extent of places suitable for various uses during the growing season and in winter.
3. Compare plants on the area with a list of plants that are known to produce local staple foods. This is to be done for each season. Map locations and quantity of staples for each season on the same map used

TABLE XIX

BASIC COVER TYPES USED BY BOBWHITES*

Plant Life-Forms Most Used	Physical Characteristics	Habitat Components Furnished
Grasses and/or Forbs	Varying from 0.3 to 1.5 meter in height Varying from 10 to 75 per cent density at ground level 0 to 20 per cent overhead concealment (canopy)	Roosting and foraging primarily; of some use for dusting and escape
Trees and/or Shrubs	One meter or more in height 0 to 25 per cent density at ground level 45 to 100 per cent overhead conceal- ment (canopy) Lateral concealment present	Resting and escape primarily; suitable for foraging and dusting

*Information given here is taken from the present study and from literature cited previously.

in step 2, or on an overlay.

4. Consider the locations of staples and of cover suitable for various uses and designate on the map or overlay the areas that are potential covey ranges for given seasons, showing where staples and cover are needed to complete them. Units of escape cover should be not more than 100 yards apart.

In determining locations of seasonal covey ranges to be completed, insure that given ranges do not exceed the area that a covey can cover daily in search of food and cover. An area of about 350 yards in greatest dimension should provide all necessary habitat components close enough together for convenient daily use.

5. Indicate on the map or overlay the location and extent of year-around covey ranges to be developed.

(a) If expense is not critical, each annual covey range may be developed by selecting any area of appropriate extent and adding as many habitat components as needed to superimpose seasonal ranges and thereby develop a small annual range. Thus the maximum number of annual covey ranges can be developed on a given tract.

(b) If funds are very limited, addition of the fewest possible habitat components may be appropriate. An annual covey range might then be composed of several seasonal ranges, some pre-existing and some added, located near each other but not necessarily superimposed. This would result in fewer annual covey ranges.

Many variations between the two extremes of development mentioned here may be selected, depending upon local circumstances.

Development

1. Add cover where needed to complete each annual covey range.

The plant life-forms given in Table XIX are not the only ones that might suffice, but they are the ones generally used, and the ones most likely to be satisfactory for year-around use. The taxa used by bobwhites in northcentral Oklahoma are given in Appendix B.

For all daytime activities maximum overhead concealment should be provided, even though lesser amounts might be tolerated, as indicated in Fig. 4.

Description of cultural methods is beyond the scope of this paper. Culture necessarily depends upon what taxa of plants are selected for development, and this must be done on a local basis.

2. Develop staple foods where needed to complete each annual covey range, using plants selected from the list used in step 2 under Evaluation.

Desirable features of food plants for developing annual covey ranges of minimum size include early maturity and persistence of seeds through several seasons, particularly through winter for use during periods of snow cover and/or frozen ground. The same end, available food in one small area all year, may be gained by planting a mixture of early- and late-maturing plants, including one or more upon which seeds persist during winter. More than one or two staples for a given season might be desirable, because of the possibility of failure to set seed.

3. In some instances, areas developed may be kept at minimum size by one of the following methods:

- (1) Use of plants suitable for both food and cover.
- (2) Use of plants that have value for more than one season.

- (3) Use of plants that combine qualities of both above types.

Comments

A supply of green vegetative material is desirable at all times. A few plants known to be used locally by bobwhites as sources of greens are mentioned in preceding sections, and reports concerning a few others are cited. However, knowledge of what plants are actually desirable, in what stage of growth, and how to provide them to wild birds is generally lacking.

A great variety of animal material, mostly insect, has been identified in bobwhite foods. However, no specific method of supplying insects to wild birds has been developed. Stoddard and Handley (1931:400) state that "Field observations show ... that there is a super-abundance of suitable animal life wherever the vegetation is kept in proper condition for quail..."

CHAPTER VI

SUMMARY

1. This study was undertaken to identify and describe components of the habitat of the bobwhite quail. The components considered were places used for roosting, daytime resting, dusting, escape, whistling and foraging, together with food items.

2. Roosting and resting places possessed the most narrowly restricted characteristics of the six components studied. Roosting places were typically surrounded by stands of taller herbaceous plants, usually bunch grasses, of low to moderate density and providing little or no overhead canopy or obstruction. Resting places were generally under low trees or shrubs which provided overhead canopy, lateral concealment and low stem density.

3. The main requirement for dusting places was an area of low stem density. Birds dusted either under canopy providing overhead concealment, or in the open. Considerable variation in height and type of vegetation present at dusting places was tolerated.

4. Cover used for escape was vegetation of at least one meter in height, and dense enough to hide the birds from the observer. Stands of low trees were used most, but grasses, shrubs and forbs were also used at times.

5. The principal characteristic of cover in foraging areas was low stem density providing room for unrestricted movement on the ground.

Birds foraged both in the open, among herbaceous plants, and under canopy provided by trees and shrubs. Height of cover varied considerably.

6. The pattern of food use was seasonal: The high utilization of foods left from previous seasons lasted until April, when a new crop of early seeds and fruits became available; these faded quickly, and by late May principal use began changing to grass seeds, which were the main foods until fall. The principal fall food items were largely different from those used in summer, and the bulk of the winter food was seeds that had been present in quantity for several months. These received increasing attention as the season progressed. The variety of foods taken during periods of snow cover was somewhat less than at other times, and bobwhites lost weight during a period of several successive snows in the winter of 1961-62.

7. Although the use of particular plant and animal taxa as food varied according to seasonal changes in their availability, the use of broad categories of foods followed a pattern applicable over much of the species' range: Bobwhites ate mostly seeds and fruits in all seasons; the proportion was less during the warmer months, when considerable animal material was used; use of vegetative material was generally the lowest, except that in winter it exceeded the use of animal material.

8. Foods taken in greatest quantity were generally among those present in considerable amounts, larger than two millimeters in greatest dimension, and persisting for relatively long periods of time, usually on the plant.

9. Male bobwhites used concealed perches in trees for whistling sites in most instances. In one area of scant tree growth, however,

males whistled from exposed perches on fenceposts, a log and a standing dead tree.

10. The habitat of the bobwhite is characterized by small units of low woody plants providing overhead canopy, lateral concealment and low stem density, closely interspersed with erect herbaceous vegetation of varying stem density and having little or no canopy.

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APPENDIX A

A List of Common and Scientific Plant Names

Appearing in this Report³

<u>Common Name</u>	<u>Scientific Name</u>
Amaranth	<u>Amaranthus</u> <u>sp.</u>
American Bittersweet	<u>Celastrus</u> <u>scandens</u> L.
American Elm	<u>Ulmus</u> <u>americana</u> L.
American Germander	<u>Teucrium</u> <u>canadense</u> L.
✓ Arrowfeather Threeawn	<u>Aristida</u> <u>purpurascens</u> Poir.
Ash	<u>Fraxinus</u> <u>sp.</u>
Aster	<u>Aster</u> <u>sp.</u>
Barnyardgrass	<u>Echinochloa</u> <u>crusgalli</u> (L.) Beauv.
Bedstraw	<u>Galium</u> <u>sp.</u>
✓ Big Bluestem	<u>Andropogon</u> <u>Gerardi</u> Vitman
Black Locust	<u>Robinia</u> <u>Pseudo-Acacia</u> L.
Blackberry	<u>Rubus</u> <u>sp.</u>
✓ Blackeyesusan	<u>Rudbeckia</u> <u>hirta</u> L.
Blackjack Oak	<u>Quercus</u> <u>marilandica</u> Muenchh.
Blackseed Plantain	<u>Plantago</u> <u>Rugelii</u> Dcne.
Boxelder	<u>Acer</u> <u>negundo</u> L.
Bristlegrass	<u>Setaria</u> <u>spp.</u>
Broadleaf Uniola	<u>Uniola</u> <u>latifolia</u> Michx.
✓ Brome	<u>Bromus</u> <u>sp.</u>
Carolina Geranium	<u>Geranium</u> <u>carolinianum</u> L.

³Common names were taken mostly from Kelsey and Dayton (1942), and scientific names from the key by Waterfall (1962). Names marked with an asterisk were taken from Anderson (1961).

<u>Common Name</u>	<u>Scientific Name</u>
Carolina Snailseed	<u>Cocculus carolinus</u> (L.) DC.
Catalpa	<u>Catalpa</u> sp.
Chervil	<u>Chaerophyllum Tainturieri</u> Hook.
Chickasaw Plum	<u>Prunus angustifolia</u> Marsh.
Common Arrowhead	<u>Sagittaria latifolia</u> Willd.
Common Honeylocust	<u>Gleditsia triacanthos</u> L.
Common Pokeberry	<u>Phytolacca americana</u> L.
Common Witchgrass	<u>Panicum capillare</u> L.
Coralberry	<u>Symphoricarpos orbiculatus</u> Moench.
Crapemyrtle	<u>Lagerstromia</u> sp.
Croton	<u>Croton glandulosus</u> L. var. <u>septentrionalis</u> Muell. Arg.
Daisy Fleabane*	<u>Erigeron strigosus</u> Muhl. ex Willd.
Dock	<u>Rumex</u> spp.
Dropseed	<u>Sporobolus</u> spp.
Eastern Black Walnut	<u>Juglans nigra</u> L.
Eastern Poplar	<u>Populus deltoides</u> Marsh.
Eastern Redbud	<u>Cercis canadensis</u> L.
Eastern Redcedar	<u>Juniperus virginiana</u> L.
Euphorbia	<u>Euphorbia</u> spp.
Fall Panicum	<u>Panicum dichotomiflorum</u> Michx.
Fall Witchgrass	<u>Leptoloma cognatum</u> Schultes Chase
Florida Paspalum	<u>Paspalum floridanum</u> Michx.
Flower-Of-An-Hour	<u>Hibiscus trioneum</u> L.
Fringeleaf Paspalum	<u>Paspalum ciliatifolium</u> Michx.
Gaillardia	<u>Gaillardia serotinum</u> (Walt.) H. Rock

<u>Common Name</u>	<u>Scientific Name</u>
Giant Ragweed	<u>Ambrosia trifida</u> L.
Goldenrod	<u>Solidago</u> sp.
Goldenweed	<u>Haplopappus ciliatus</u> (Nutt.) DC.
Gramma	<u>Bouteloua</u> sp.
Grape	<u>Vitis</u> spp.
Grass	Gramineae
Greenbriar	<u>Smilax</u> sp.
Hackberry	<u>Celtis</u> sp.
Hairy Crabgrass	<u>Digitaria sanguinalis</u> (L.) Scop.
Hawthorn	<u>Crataegus</u> sp.
Heath Aster	<u>Aster ericoides</u> L.
Horseweed Fleabane	<u>Gonyza canadensis</u> (L.) Cronq.
Iberian Violet	<u>Viola kitaibeliana</u> R. & S.
Illinois Bundleflower	<u>Desmanthus illinoensis</u> (Michx.) MacM.
Indigo Amorpha	<u>Amorpha fruticosa</u> L.
Japanese Brome	<u>Bromus japonicus</u> Thunb.
Johnsongrass	<u>Sorghum halepense</u> (L.) Pers.
Kentucky Coffee Tree	<u>Gymnocladus dioica</u> (L.) K. Koch
Knotweed	<u>Polygonum</u> spp.
Lambsquarters Goosefoot	<u>Chenopodium album</u> L.
Lespedeza	<u>Lespedeza capitata</u> Michx. and <u>L. virginica</u> (L.) Britt.
Lettuce	<u>Lactuca</u> sp.
Lilac	<u>Syringa</u> sp.
Little Bluestem	<u>Andropogon scoparius</u> Michx.
Louisiana Sagebrush	<u>Artemisia ludoviciana</u> Nutt.

<u>Common Name</u>	<u>Scientific Name</u>
Mat Sandbur	<u>Genchrus pauciflorus</u> Benth.
Mulberry	<u>Morus spp.</u>
Nightshade	<u>Solanum americanum</u> Mill.
Nimblewill	<u>Muhlenbergia Schreberi</u> J. F. Gmel.
Oak	<u>Quercus marilandica</u> Muenchh. and <u>Q. stellata</u> Wang.
Osageorange	<u>Maclura pomifera</u> (Raf.) Schneider
Panicum	<u>Panicum scribnerianum</u> Nash*, et al.
Peach	<u>Prunus sp.</u>
Pear	<u>Pyrus sp.</u>
Pink Wildbean	<u>Strophostyles umbellata</u> (Muhl.) Britt.
Post Oak	<u>Quercus stellata</u> Wang.
Prairie Acacia	<u>Acacia augustissima</u> (Mill.) Kuntze
Prairie Threeawn	<u>Aristida oligantha</u> Michx.
Prostrate Knotweed	<u>Polygonum aviculare</u> L.
Purple Lovegrass	<u>Eragrostis spectabilis</u> (Pursh) Steud.
✓ Purpletop	<u>Tridens flavus</u> (L.) Hitchc.
Rough Buttonweed	<u>Diodia teres</u> Walt.
Roughleaf Dogwood*	<u>Cornus Drummondii</u> Meyer
Rusty Blackhaw Viburnum	<u>Viburnum prunifolium</u> L. var. <u>Rufidulum</u>
Scribner Panicum*	<u>Panicum scribnerianum</u> Nash*
Sedge	Cyperaceae
✓ Showy Partridgepea	<u>Cassia fasciculata</u> Michx.
✓ Sideoats Grama	<u>Bouteloua curtipendula</u> (Michx.) Torr.

<u>Common Name</u>	<u>Scientific Name</u>
Silver Bluestem	<u>Andropogon saccharoides</u> SW.
Silverleaf Nightshade	<u>Solanum eleagnifolium</u> Cav.
Slender Lespedeza	<u>Lespedeza virginica</u> (L.) Britt.
Slenderlobed Bundleflower*	<u>Desmanthus leptolobus</u> T. & G.
Slimflower Scurfpea	<u>Psoralea tenuiflora</u> Pursh
Slimleaf Panicum	<u>Panicum linearifolium</u> Scribn.
Smooth Sumac	<u>Rhus glabra</u> L.
Snow-On-The-Mountain Euphorbia	<u>Euphorbia marginata</u> Pursh
Sorghum	<u>Sorghum vulgare</u> Pers.
Splitbeard Bluestem*	<u>Andropogon ternarius</u> Michx.
Sumac	<u>Rhus copallina</u> L. and <u>R. glabra</u> L.
Sunflower	<u>Helianthus</u> sp.
Sweetclover	<u>Melilotus</u> sp.
Switchgrass	<u>Panicum virgatum</u> L.
Terragon Snakeweed	<u>Gutierrezia dracunculoides</u> (DC.) Blake
Tickclover	<u>Desmodium</u> spp.
Trailing Wildbean	<u>Strophostyles helvola</u> (L.) Ell.
Tumble Windmillgrass	<u>Chloris verticillata</u> Nutt.
Verbena	<u>Verbena</u> sp.
Violet Woodsorrel Oxalis	<u>Oxalis violacea</u> L.
Western Ragweed	<u>Ambrosia psilostachya</u> DC.
Western Soapberry	<u>Sapindus Drummondii</u> H. & A.
Western Yarrow	<u>Achillea lanulosa</u> Nutt.
Wheat*	<u>Triticum</u> sp.

<u>Common Name</u>	<u>Scientific Name</u>
White Crownbeard	<u>Verbesina virginica</u> L.
White Sweetclover	<u>Melilotus alba</u> Desv.
Wildrye	<u>Elymus canadensis</u> L. & <u>E. virginicus</u> L.
Willow	<u>Salix</u> sp.
Woolly Croton	<u>Croton capitatus</u> Michx.
Woollybucket Bumelia	<u>Bumelia lanuginosa</u> (Michx.) Pers.
Yellow Indiangrass	<u>Sorghastrum nutans</u> (L.) Nash
Yellowsedge Bluestem	<u>Andropogon virginicus</u> L.

A List of Common and Technical Arthropod

Names Appearing in this Report⁴

<u>Common Name</u>	<u>Technical Name</u> ⁵
Ant	Hymenoptera, Formicidae
Beetle	Coleoptera
Burrower Bug	Hemiptera, Cydnidae
Froghopper	Homoptera, Cercopidae
Grasshopper	Orthoptera, Acrididae
Ground Beetle	Coleoptera, Carabidae
Insect	Class Insecta
Leaf Beetle	Coleoptera, Chrysomelidae
Leafhopper	Homoptera, Cicadellidae
Metallic Beetle	Coleoptera, family uncertain
Snout Beetle	Coleoptera, Curculionidae
Spider	Class Arachnida
Spotted Cucumber Beetle	Coleoptera, Chrysomelidae
	<u>Diabrotica duodecimpunctatus</u> (Fabricius)
Stinkbug	Hemiptera, Pentatomidae
True Bug	Hemiptera

⁴Insect names were taken from Borror and DeLong (1954).

⁵Order and Family unless otherwise indicated.

APPENDIX B

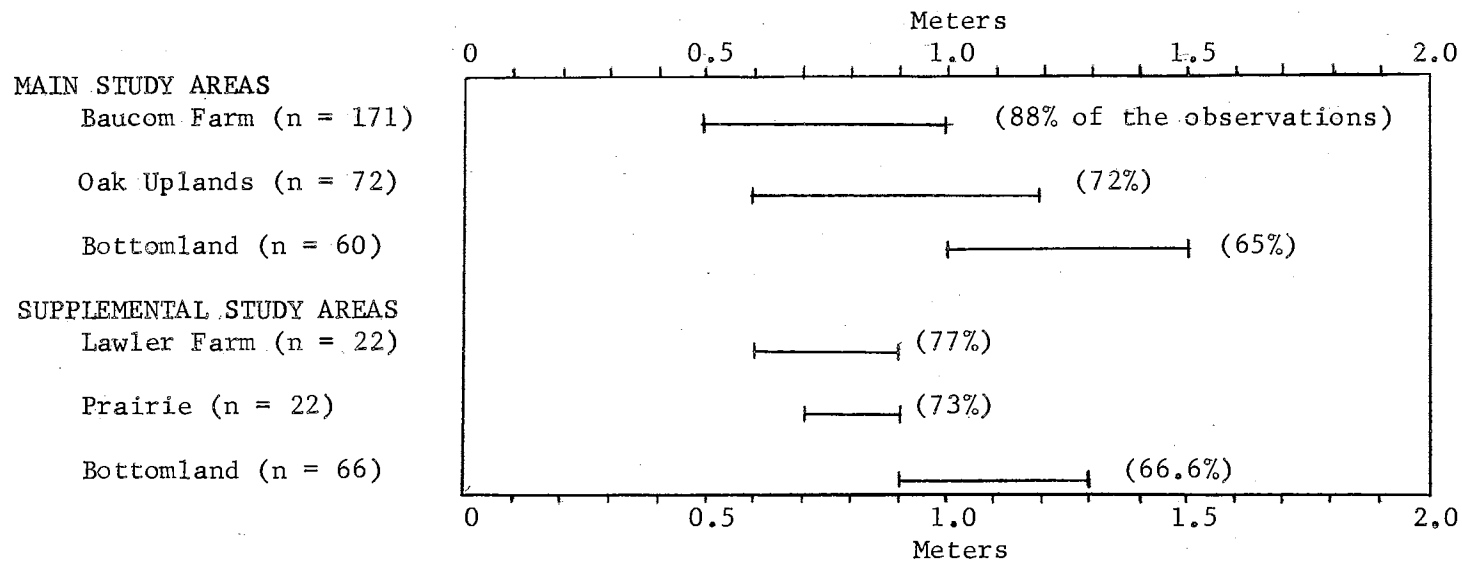


Fig. 7. Height of cover at roosting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

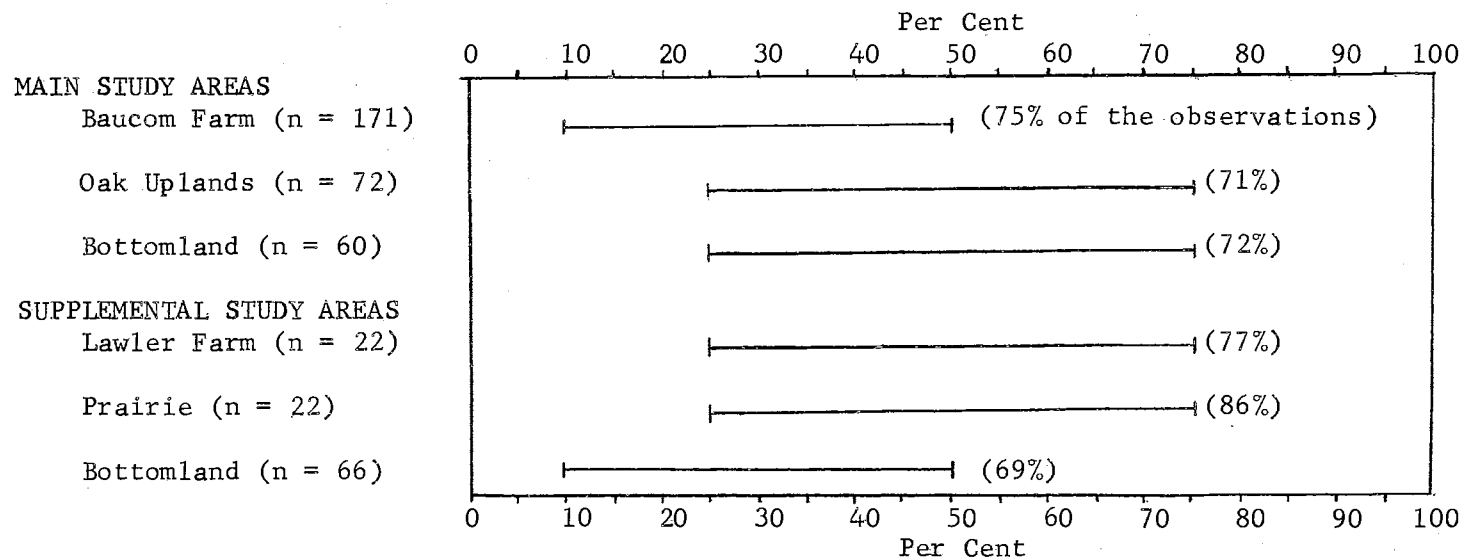


Fig. 8. Per cent density at ground level of cover at roosting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

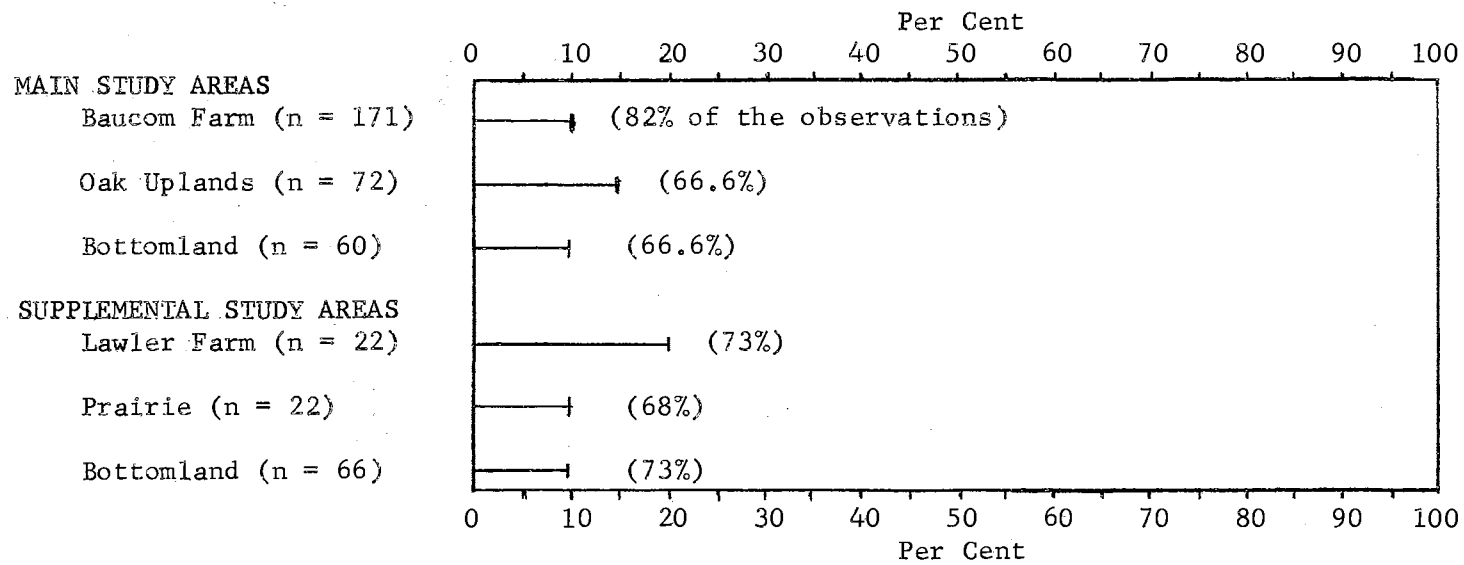


Fig. 9. Per cent overhead concealment provided by cover at roosting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

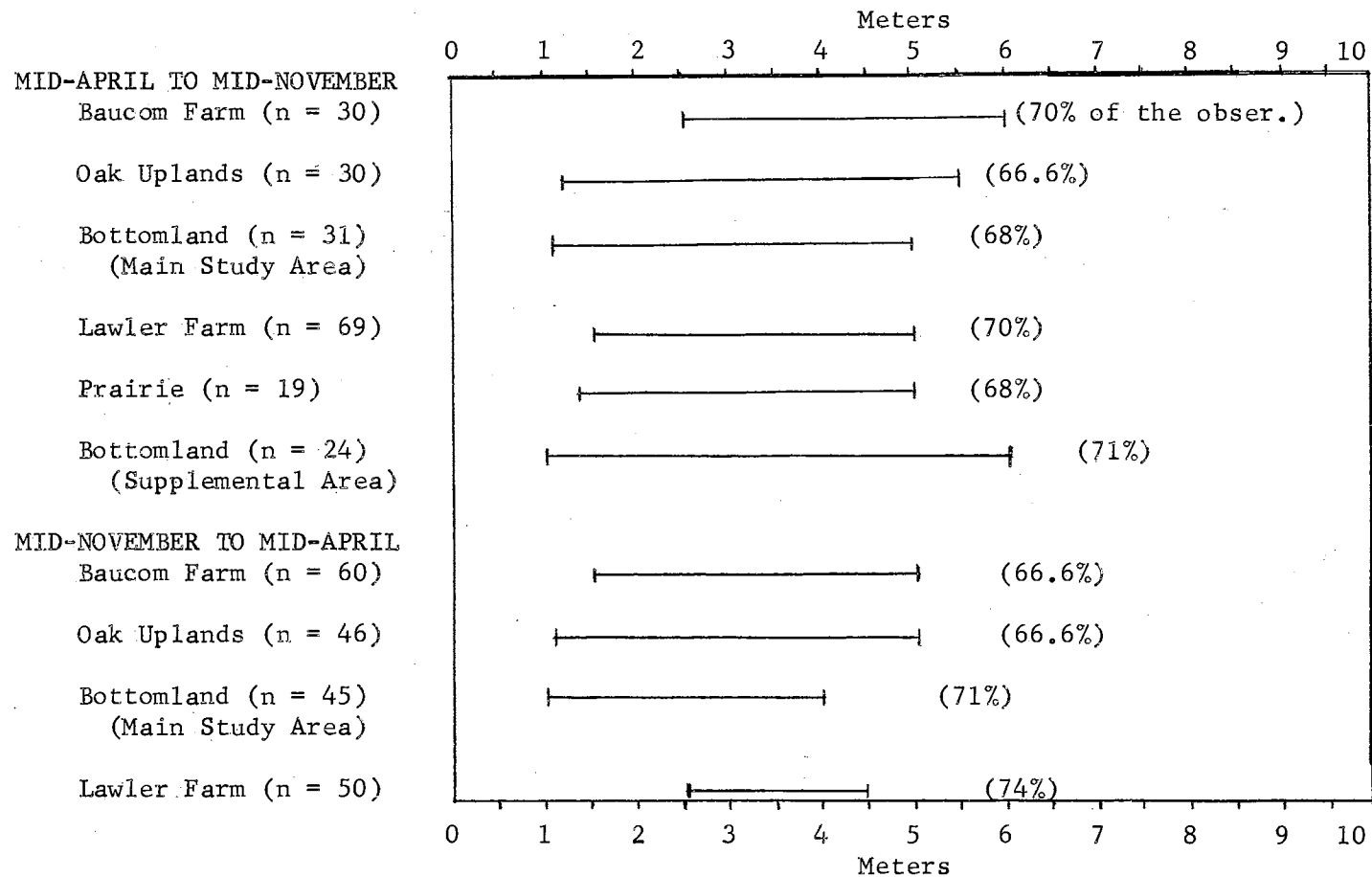


Fig. 10. Height of cover at resting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

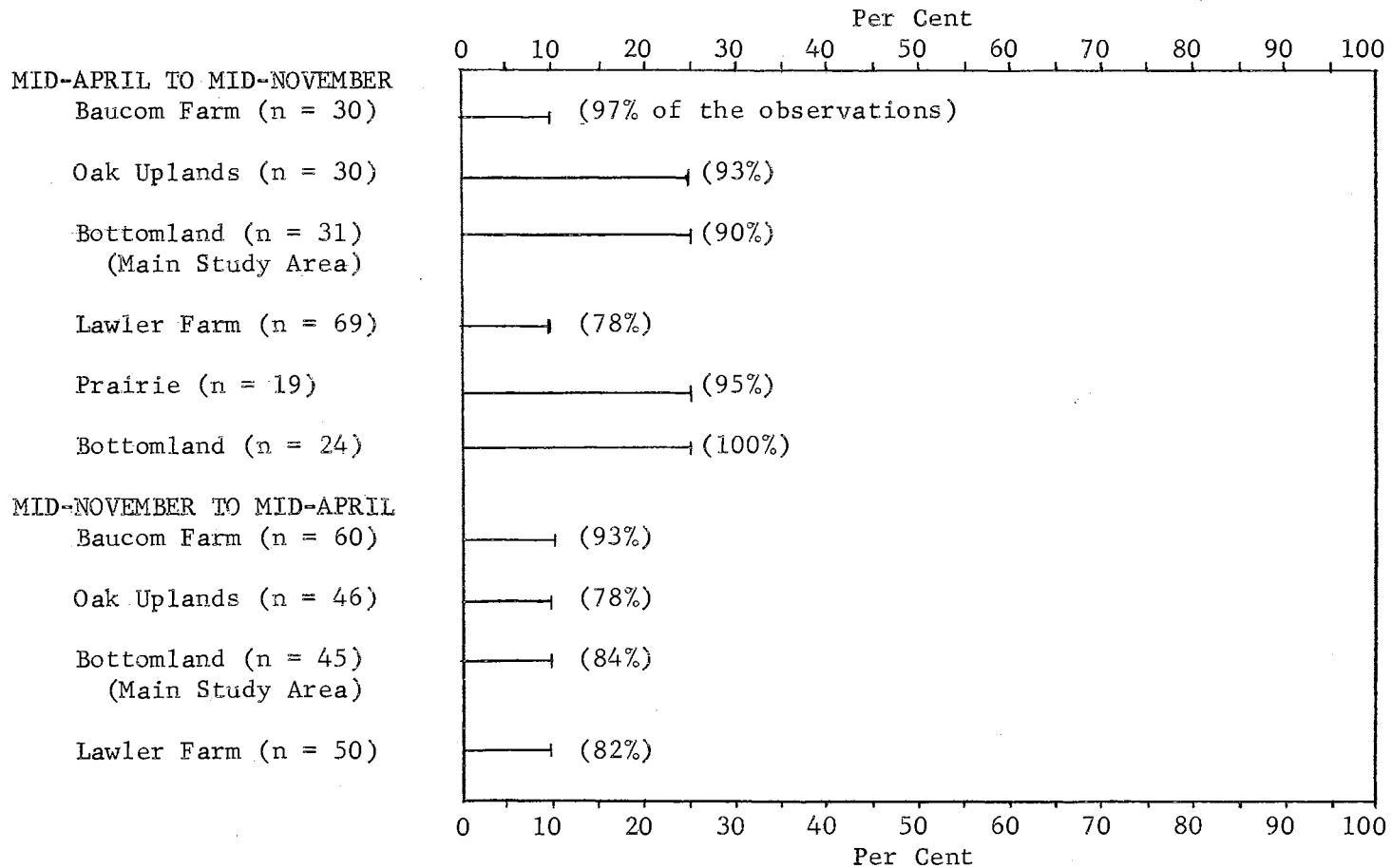


Fig. 11. Per cent density at ground level of cover at resting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

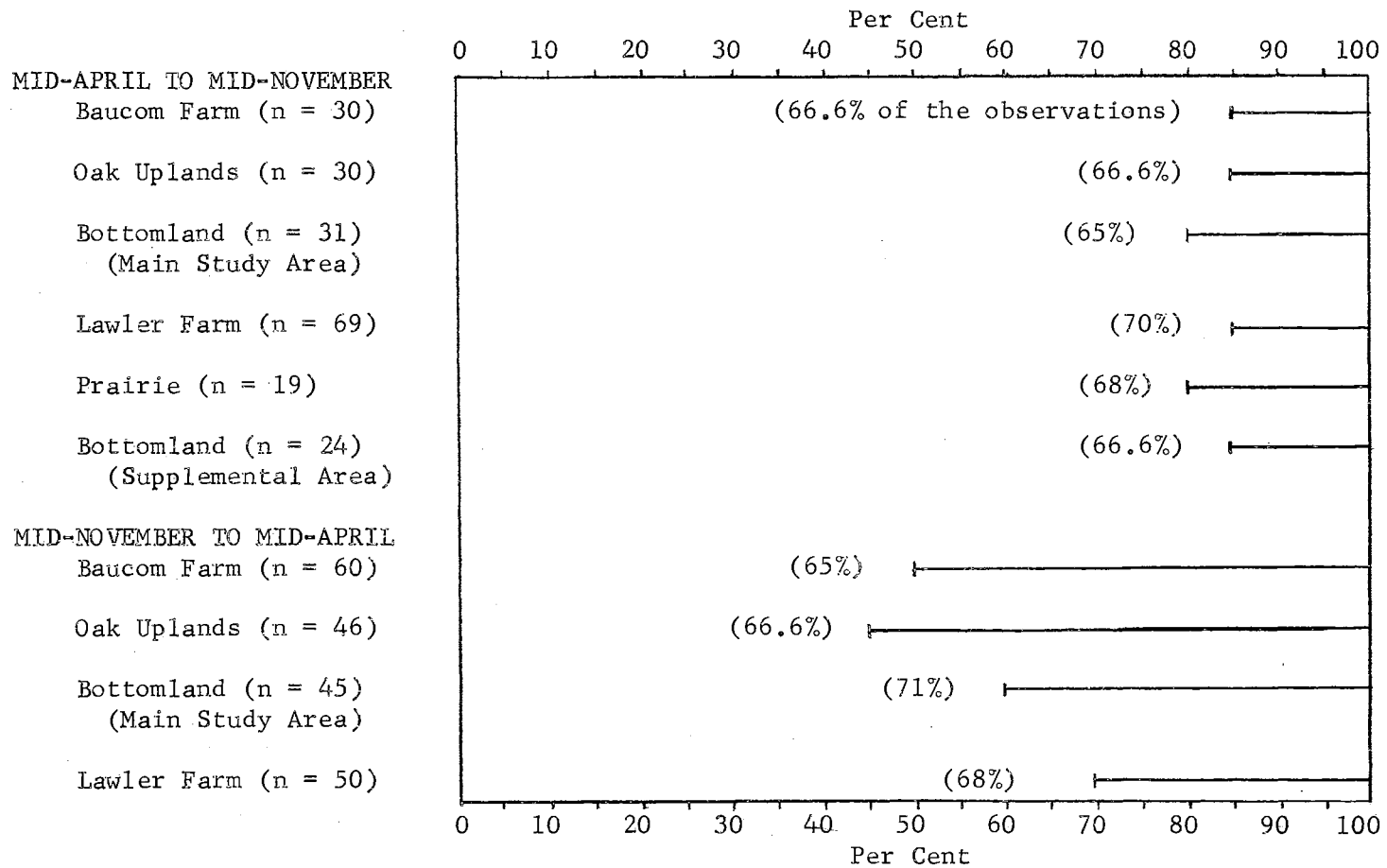


Fig. 12. Per cent overhead concealment provided by cover at resting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the left end of the line.

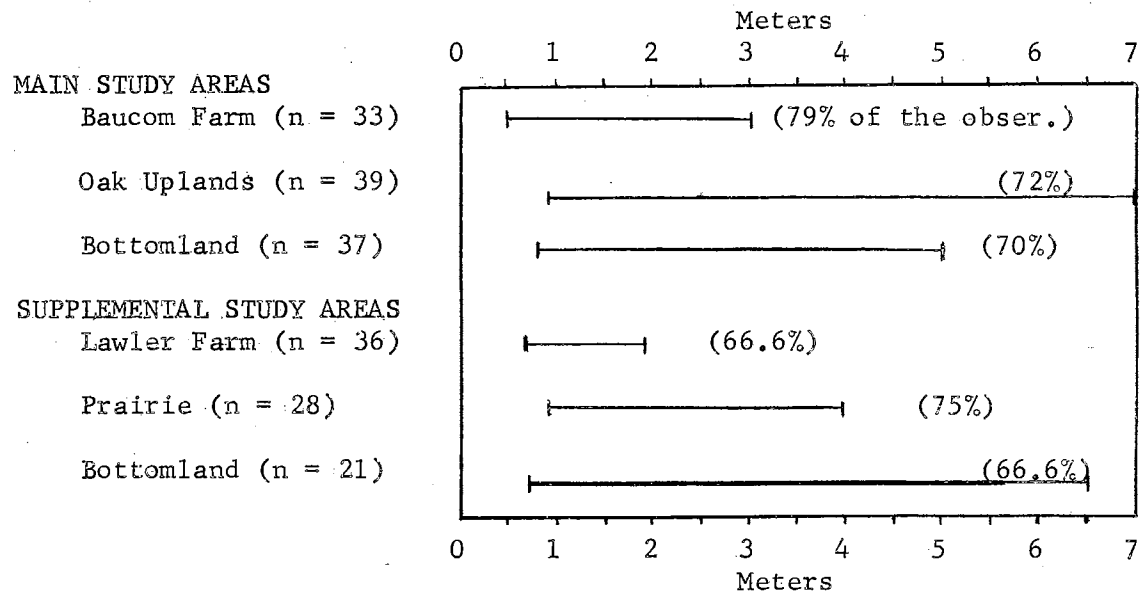


Fig. 13. Height of cover at dusting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

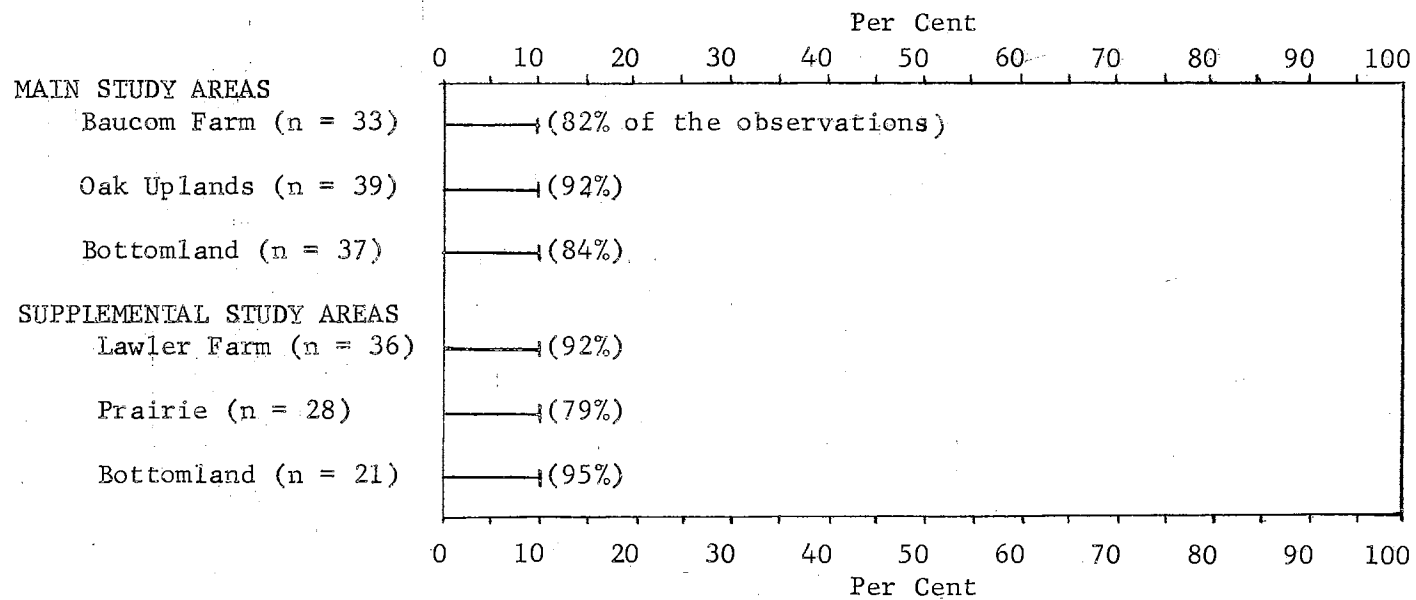


Fig. 14. Per cent density at ground level of cover at dusting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

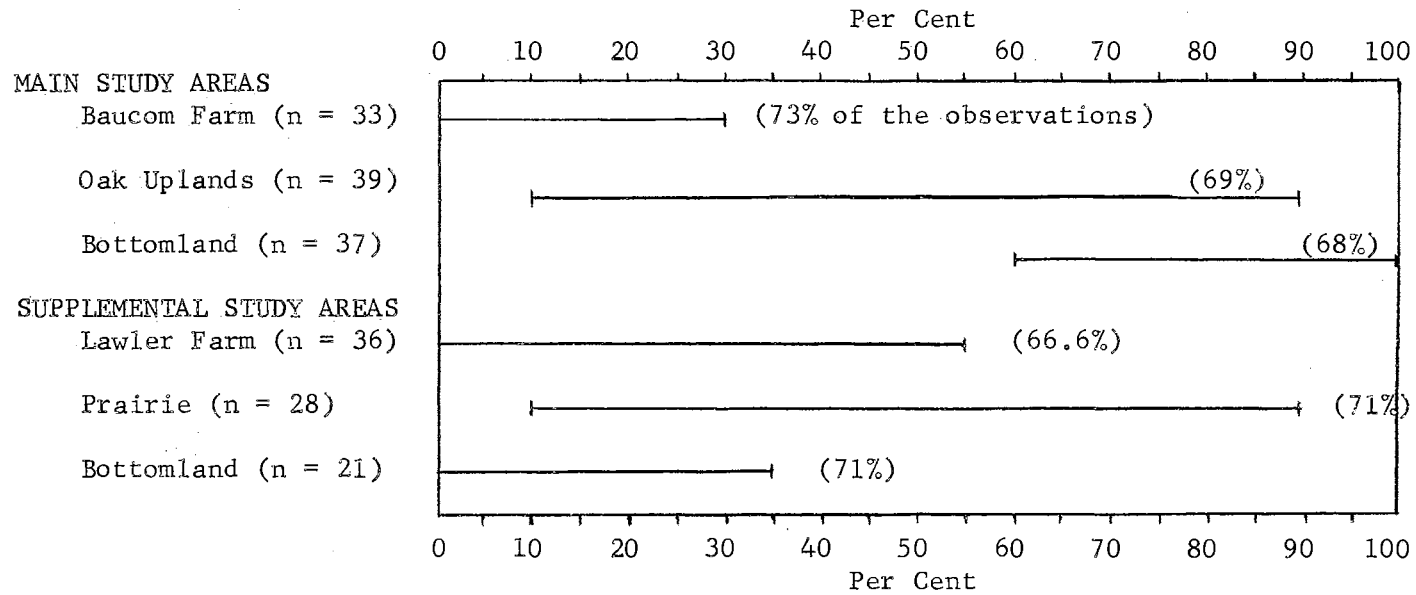


Fig. 15. Per cent overhead concealment provided by cover at dusting places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

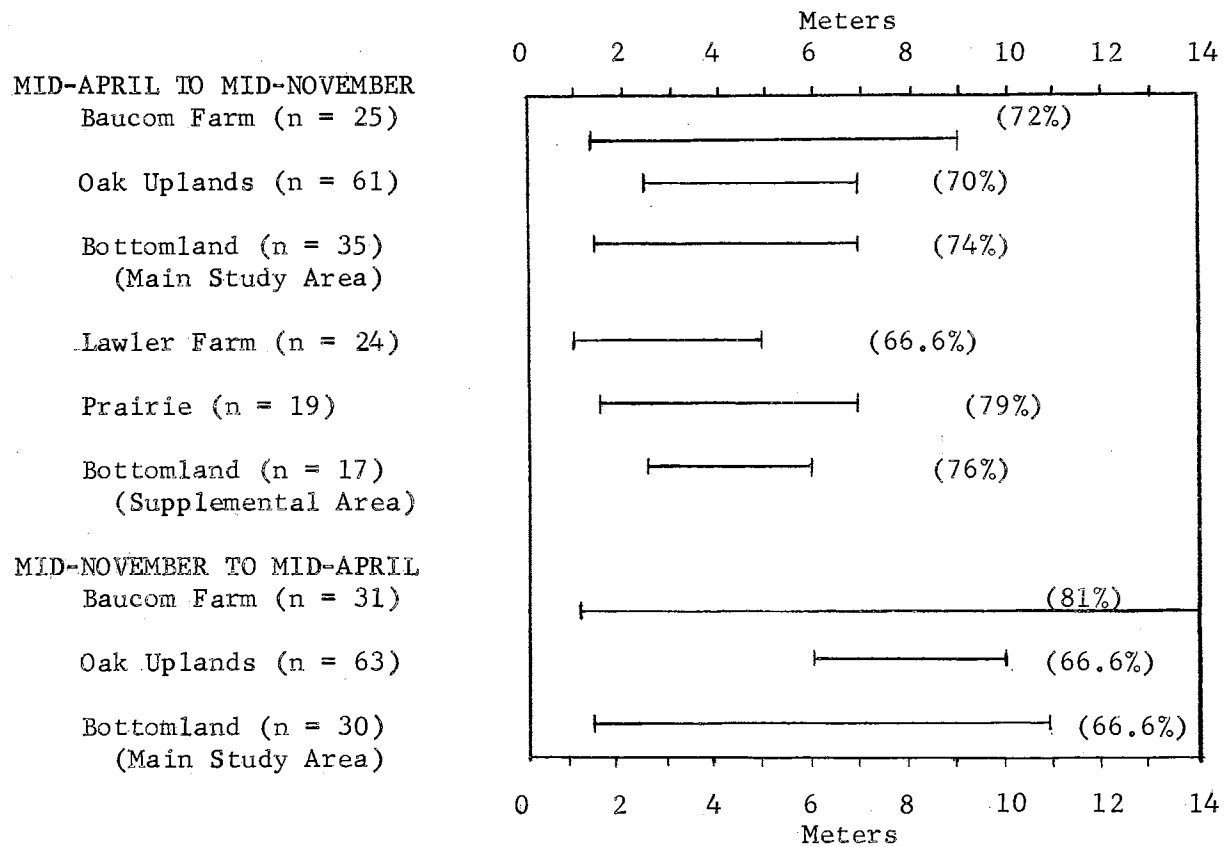


Fig. 16. Height of cover at places used by bobwhites for escape. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

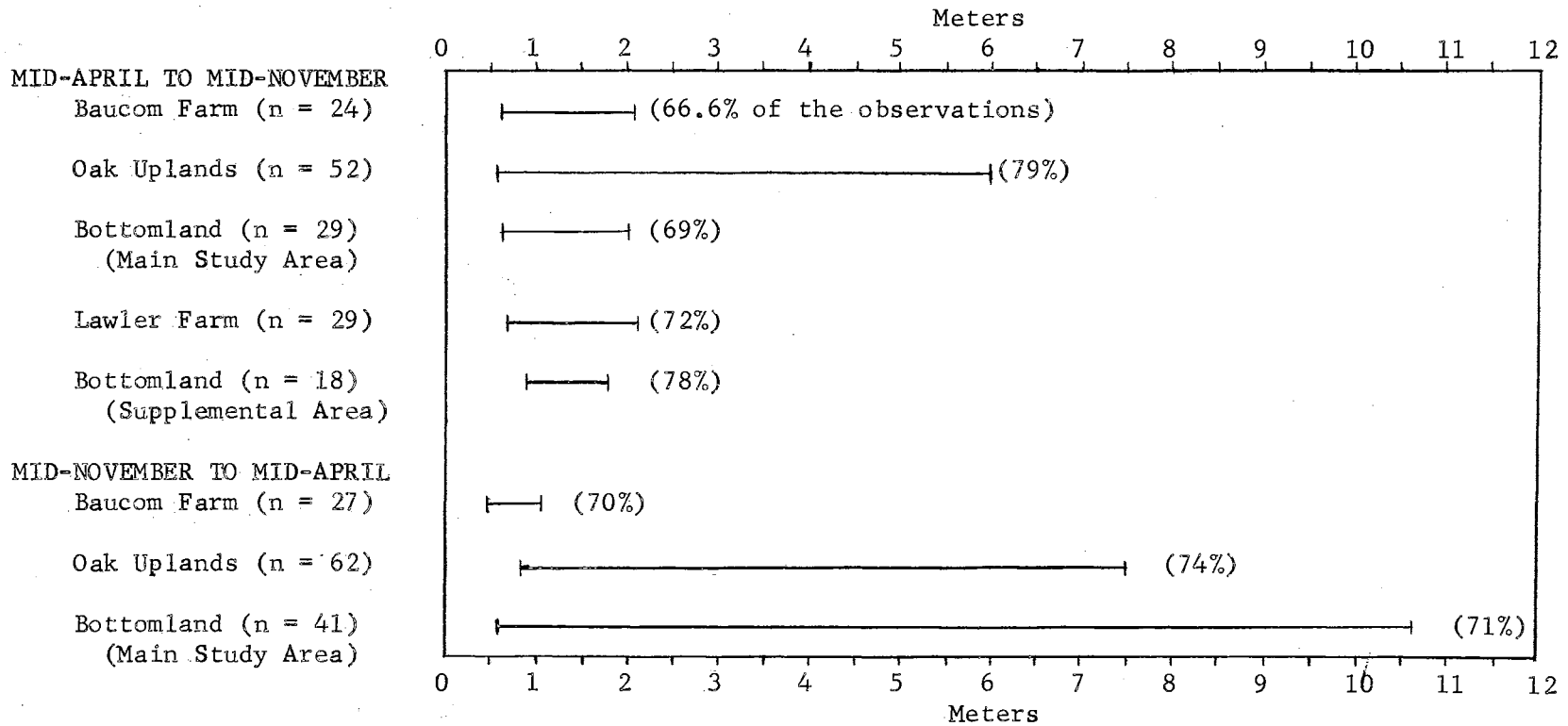


Fig. 17. Height of cover at foraging places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

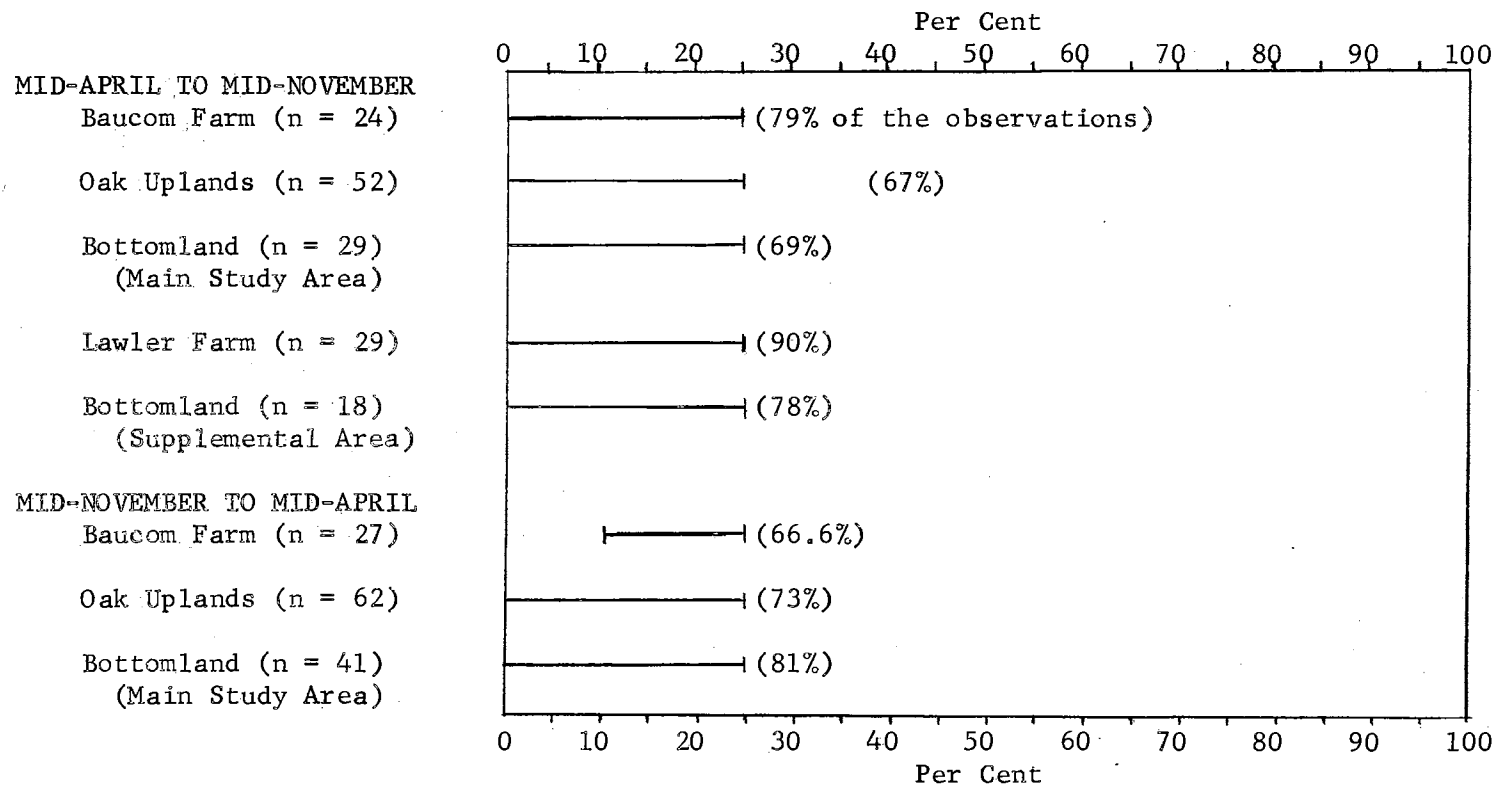


Fig. 18. Per cent density at ground level of cover at foraging places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

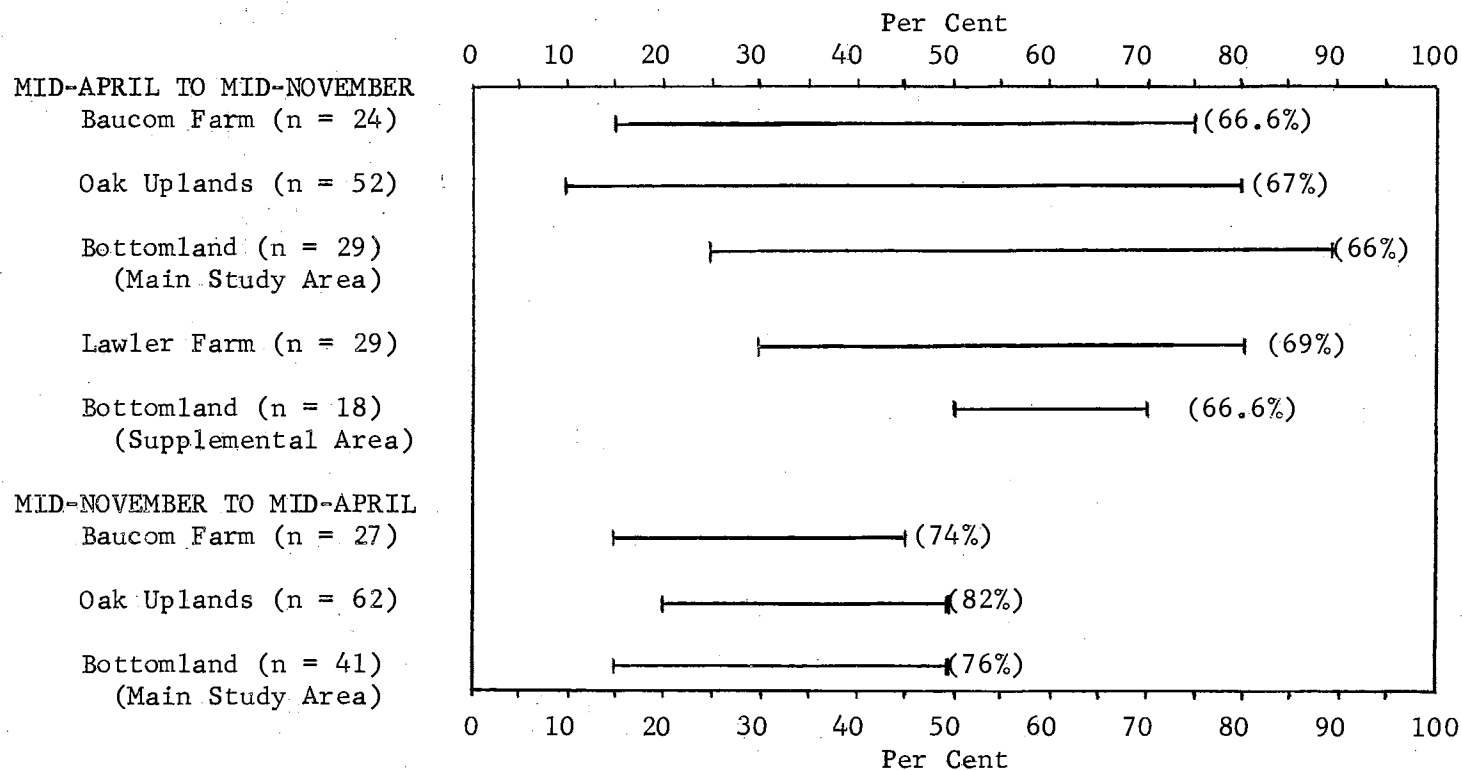


Fig. 19. Per cent overhead concealment provided by cover at foraging places of bobwhites. For each sample, "n" represents the number of observations, and the horizontal line indicates the range within which at least two-thirds of the observations occurred. The actual percentage occurring within a given range is shown at the right end of the line.

TABLE XX

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT ROOSTING PLACES OF BOBWHITES ON THE MAIN STUDY AREAS

	Baucom Farm	Oak Uplands	Bottomland	
Grasses	Little Bluestem	62	Little Bluestem 42	Little Bluestem 40
	Mat Sandbur	55	Yellow	Yellow
	Prairie		Indiangrass 21	Indiangrass 37
	Threeawn	19	Big Bluestem 13	Big Bluestem 13
	Hairy Crabgrass	16	Silver Bluestem 12	Splitbeard
	Panicum	13	Splitbeard	Bluestem 5
	Yellow		Bluestem 6	Purpletop 1
	Indiangrass	12	Dropseed 4	
	Switchgrass	7	Panicum 4	
	Johnsongrass	7	Switchgrass 3	
	Big Bluestem	6	Sideoats Grama 2	
	Splitbeard		Yellowsedge	
	Bluestem	5	Bluestem 1	
	Fall Witchgrass	4	Fall Witchgrass 1	
	Arrowfeather			
	Threeawn	3		
	Gramma	2		
	Purpletop	1		
	Forbs	Goldenweed	9	Western Ragweed 1
Aster		6		
Rough				
Buttonweed		5		
Gaillardia		3		
Western Ragweed		3		
Euphorbia		1		
Terragon				
Snakeweed	1			
Shrubs	Chickasaw Plum	1	-	Hawthorn 1
	Coralberry	1		
	Sumac	1		
Vines	Trailing			
	Wildbean	2	-	-
Fallen				
Treetop	-	Fallen Treetop 2	-	

TABLE XXI

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT ROOSTING PLACES OF BOBWHITES ON THE SUPPLEMENTAL STUDY AREAS

	Lawler Farm	Prairie	Bottomland
Grasses	Splitbeard	Little Bluestem 20	Little Bluestem 41
	Bluestem 10	Yellow	Yellow
	Dropseed 4	Indiangrass 10	Indiangrass 20
	Little Bluestem 4	Arrowfeather	Splitbeard
	Prairie Threeawn 1	Threeawn 1	Bluestem 11
	Yellow	Gramma 1	Panicum 8
	Indiangrass 1	Prairie	Yellowsedge
	Yellowsedge	Threeawn 1	Bluestem 4
	Bluestem 1	Splitbeard	Switchgrass 4
		Bluestem 1	Purpletop 2
		Switchgrass 1	
	Forbs	Western Ragweed 5	-
Louisiana			Western
Sagebrush 1			Ragweed 2
Lambsquarters			Giant Ragweed 1
Goosefoot 1			
Shrubs	Coralberry 2	-	-

TABLE XXII

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT RESTING PLACES OF BOBWHITES ON THE MAIN STUDY AREAS (MID-APRIL TO MID-NOVEMBER)

	Baucom Farm	Oak Uplands	Bottomland			
Trees	Hackberry	10	Oak	13	American Elm	14
	American Elm	9	Hackberry	5	Boxelder	2
	Mulberry	3	Black Locust	2	Eastern Redcedar	2
	Eastern Black Walnut	1	American Elm	1	Hackberry	2
	Oak	1	Pear	1	Eastern Black Walnut	1
					Woollybucket	
					Bumelia	1
Shrubs	Chickasaw Plum	6	Coralberry	5	Roughleaf	
	Roughleaf		Roughleaf		Dogwood	4
	Dogwood	4	Dogwood	2		
	Sumac	4				
Grass and Grass-Like	-		Little Bluestem	1	Common Arrowhead	2
					Johnsongrass	2
					Big Bluestem	1
					Yellow Indiangrass	1
Forbs	-				Western Ragweed	1
Vines	-		Grape	1	Greenbriar	1
Fallen Trees	Fallen Tree	1	-		-	

TABLE XXIII

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT RESTING PLACES OF
BOBWHITES ON THE SUPPLEMENTAL STUDY AREAS
(MID-APRIL TO MID-NOVEMBER)

	Lawler Farm	Prairie	Bottomland			
Trees	Osageorange	17	Oak	10	American Elm	6
	American Elm	12	Hackberry	2	Eastern	
	Eastern		American Elm	2	Redcedar	1
	Redcedar	10	Common		Hackberry	1
	Oak	6	Honeylocust	1		
	Eastern Poplar	5	Mulberry	1		
	Hackberry	4				
	Willow	3				
	Mulberry	1				
	Boxelder	1				
Shrubs	Indigo Amorpha	2	-	Lilac	2	
	Chickasaw Plum	1		Coralberry	2	
	Roughleaf			Roughleaf		
	Dogwood	1		Dogwood	2	
			Sumac	2		
Grasses & Grass-Like	Yellow		Sedge	2	Sorghum	2
	Indiangrass	3	Switchgrass	2	Johnsongrass	1
	Little Bluestem	2				
	Johnsongrass	2				
	Grama	1				
	Switchgrass	1				
Forbs	Western Ragweed	2	-	Lambsquarters		
	Lambsquarters			Goosefoot	2	
	Goosefoot	1		Sunflower	2	
	Louisiana			Western		
	Sagebrush	1		Ragweed	2	
	Terragon					
Snakeweed	1					
Fallen Trees	Fallen Tree	1	-	-		
Artifacts	Fence	5	-	-		
	Barrel	1				
	Building	1				

TABLE XXIV

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT RESTING PLACES OF BOBWHITES ON THE MAIN STUDY AREAS AND ONE SUPPLEMENTAL STUDY AREA (MID-NOVEMBER TO MID-APRIL)

	Baucom Farm		Oak Uplands		Bottomland		Lawler Farm	
Trees	American Elm	9	Oak	12	American Elm	13	Osageorange	29
	Hackberry	3	Eastern Redcedar	10	Eastern Redcedar	9	Eastern Redcedar	15
	Eastern Redcedar	2	American Elm	6	Oak	2	Oak	2
	Eastern Black Walnut	1	Hackberry	4	Woollybucket		American Elm	2
	Mulberry	1	Woollybucket		Bumelia	1		
	Willow	1	Bumelia	2				
	Woollybucket							
	Bumelia	1						
Shrubs	Chickasaw Plum	19	Coralberry	3	Roughleaf		Coralberry	1
	Sumac	12	Sumac	2	Dogwood	4		
			Chickasaw Plum	1	Sumac	2		
			Roughleaf		Coralberry	1		
			Dogwood	1	Rusty Blackhaw			
					Viburnum	1		
Grasses	Little Bluestem	2	-		Broadleaf		-	
	Switchgrass	1			Uniola	1		
Forbs	Aster	1	Western Ragweed	1	Tickclover	1	-	

TABLE XXIV (Continued)

Baucom Farm			Oak Uplands		Bottomland		Lawler Farm	
Vines	Greenbriar	9	Greenbriar	1	Greenbriar	6	-	
Fallen Trees, Etc.	Fallen limbs	2	Fallen limbs	3	Log	5	-	
	Driftwood	1	Log	3	Driftwood	1		
	Log	1						
	Stump	1						
Artifacts	-		Fencepost	1	-		Automobile	1
							Automobile seat springs	1

TABLE XXV

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT DUSTING PLACES OF BOBWHITES ON THE MAIN STUDY AREAS

	Baucom Farm		Oak Uplands		Bottomland	
Trees	Hackberry	3	Oak	17	American Elm	9
	American Elm	1	Eastern		Eastern	
	Mulberry	1	Redcedar	6	Redcedar	5
	Oak	1	Hackberry	5	Oak	3
			Woollybucket		Hackberry	2
			Bumelia	5	Eastern Black	
			Black Locust	2	Walnut	1
					Mulberry	1
Shrubs	Roughleaf		Coralberry	2	Roughleaf	
	Dogwood	5	Crapemyrtle	1	Dogwood	3
	Chickasaw		Sumac	1	Sumac	2
	Plum	2				
	Sumac	2				
Grasses	Little Bluestem	5	Little Bluestem	6	Silver	
	Big Bluestem	4	Silver Bluestem	3	Bluestem	4
	Johnsongrass	2	Big Bluestem	2	Little	
	Prairie		Yellow		Bluestem	3
	Threeawn	2	Indiangrass	1	Yellowsedge	
	Yellow		Wildrye	1	Bluestem	2
	Indiangrass	2			Big Bluestem	1
	Hairy Crabgrass	1			Hairy Crabgrass	1
	Sideoats Grama	1			Johnsongrass	1
					Sideoats Grama	1
				Grama	1	
Forbs	Goldenweed	6	-		Western	
	Horseweed				Ragweed	3
	Fleabane	2			Lambsquarters	
	Sunflower	2			Goosefoot	1
	Western					
	Ragweed	2				
	Louisiana Sagebrush	1				
Vines	-		Greenbriar	3	-	
			Carolina			
			Snailseed	1		
			Grape	1		
Fallen Trees	-	Fallen Tree	1	Fallen Tree	1	

TABLE XXVI

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT DUSTING PLACES OF BOBWHITES ON THE SUPPLEMENTAL STUDY AREAS

	Lawler Farm		Prairie		Bottomland	
Trees	Osageorange	2	Oak	19	American Elm	3
	American Elm	1	American Elm	1		
	Mulberry	1				
	Oak	2				
Shrubs	Coralberry	1	Roughleaf			
			Dogwood	1		
Grasses	Johnsongrass	4	Grama	1	Little	
	Little Bluestem	1	Johnsongrass	1	Bluestem	4
	Silver Bluestem	1	Little Bluestem	1	Silver	
			Prairie Threeawn	1	Bluestem	3
			Purple Lovegrass	1	Sorghum	3
			Sideoats Grama	1	Johnsongrass	1
			Switchgrass	1		
Forbs	Lambsquarters		Western Ragweed	2	Lambsquarters	
	Goosefoot	10	Louisiana		Goosefoot	3
	Western Ragweed	8	Sagebrush	1	Knotweed	2
	Terragon		Rough Buttonweed	1	Sunflower	2
	Snakeweed	6	Terragon		Western	
	Louisiana		Snakeweed	1	Ragweed	2
	Sagebrush	3			Amaranth	1
	Goldenweed	2			Goldenweed	1
	Sunflower	1				
Nightshade	1					
Artifacts	Fence	2				

TABLE XXVII

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT PLACES USED BY
BOBWHITES FOR ESCAPE ON THE MAIN STUDY AREAS
(MID-APRIL TO MID-NOVEMBER)

	Baucom Farm		Oak Uplands		Bottomland	
Trees	American Elm	9	Oak	41	American Elm	22
	Hackberry	5	Hackberry	9	Eastern Black	
	Eastern Black		Black Locust	5	Walnut	3
	Walnut	3	American Elm	3	Hackberry	3
	Eastern Poplar	2	Eastern		Mulberry	1
	Oak	1	Redcedar	2	Oak	1
			Woollybucket		Woollybucket	
			Bumelia	1	Bumelia	1
			Western			
			Soapberry	1		
Shrubs	Sumac	4	Sumac	2	Hawthorn	1
	Chickasaw Plum	3	Roughleaf		Sumac	1
	Peach	2	Dogwood	1		
			Chickasaw Plum	1		
Grasses	Johnsongrass	2	Little		Johnsongrass	5
	Little Bluestem	2	Bluestem	5	Little Bluestem	4
	Arrowfeather		Yellow		Big Bluestem	2
	Threeawn	1	Indiangrass	2	Splitbeard	
	Mat Sandbur	1	Johnsongrass	1	Bluestem	2
	Wildrye	1	Yellowsedge		Yellow	
			Bluestem	1	Indiangrass	2
				Switchgrass	1	
Forbs	Sunflower	2	-		Giant Ragweed	1
	Terragon					
	Snakeweed	1				

TABLE XXVIII

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT PLACES USED BY
BOBWHITES FOR ESCAPE ON THE SUPPLEMENTAL STUDY AREAS
(MID-APRIL TO MID-NOVEMBER)

	Lawler Farm		Prairie		Bottomland	
Trees	Eastern Poplar	4	Oak	6	American Elm	13
	American Elm	3	American Elm	5	Hackberry	3
	Osageorange	3	Willow	5	Western	
	Eastern		Hackberry	3	Soapberry	2
	Redcedar	1	Common		Ash	1
			Honeylocust	1	Black Locust	1
			Eastern Poplar	1	Willow	1
			Ash	1		
			Catalpa	1		
			Osageorange	1		
	Shrubs	Roughleaf		Roughleaf		-
Dogwood		1	Dogwood	1		
Grasses	Johnsongrass	5	Little		Big Bluestem	1
	Little Bluestem	5	Bluestem	2	Johnsongrass	1
	Sideoats Grama	2	Prairie		Little Bluestem	1
	Splitbeard		Threeawn	1	Sideoats Grama	1
	Bluestem	2	Sideoats		Switchgrass	1
	Switchgrass	2	Gramma	1		
	Yellow		Splitbeard			
	Indiangrass	1	Bluestem	1		
			Yellow			
			Indiangrass	1		
Forbs	Western Ragweed	3	-		Terragon	
	Giant Ragweed	1			Snakeweed	1
	Goldenweed	1			Verbena	1
	Lambsquarters				Western Ragweed	1
	Goosefoot	1				
	Terragon					
	Snakeweed	1				

TABLE XXIX

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT PLACES USED BY
BOBWHITES FOR ESCAPE ON THE MAIN STUDY AREAS
(MID-NOVEMBER TO MID-APRIL)

	Baucom Farm		Oak Uplands		Bottomland	
Trees	American Elm	11	Oak	38	American Elm	14
	Oak	9	Hackberry	29	Hackberry	4
	Hackberry	7	American Elm	13	Eastern Black	
	Eastern Poplar	3	Woollybucket		Walnut	2
			Bumelia	4	Eastern Poplar	1
			Eastern		Oak	1
			Redcedar	3	Rusty Blackhaw	
					Viburnum	1
					Western	
					Soapberry	1
Shrubs	Chickasaw Plum	1	Chickasaw			
	Sumac	1	Plum	2		
			Sumac	2		
Grasses	Little Bluestem	9	Little		Yellow	
	Switchgrass	4	Bluestem	4	Indiangrass	6
	Johnsongrass	3	Johnsongrass	2	Johnsongrass	5
	Yellow		Switchgrass	2	Little Bluestem	4
	Indiangrass	2	Splitbeard		Purpletop	2
	Big Bluestem	1	Bluestem	1	Yellowsedge	
	Purpletop	1	Yellow		Bluestem	1
	Splitbeard		Indiangrass	1		
	Bluestem	1	Yellowsedge			
			Bluestem	1		

TABLE XXX

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT FORAGING PLACES
OF BOBWHITES ON THE MAIN STUDY AREAS
(MID-APRIL TO MID-NOVEMBER)

	Baucom Farm		Oak Uplands		Bottomland	
Trees	American Elm	3	Oak	12	American Elm	2
	Oak	1	Black Locust	2	Hackberry	1
	Hackberry	1	Hackberry	2	Mulberry	1
			Eastern Redcedar	1	Western Soapberry	1
			Pear	1		
Shrubs	Chickasaw Plum	4			Coralberry	2
	Roughleaf				Sumac	1
	Dogwood	3				
Vines			Blackberry	1		
Forbs	Goldenweed	5	Western Ragweed	8	Western Ragweed	6
	Sunflower	4	Louisiana Sage-		Common Pokeberry	1
	Croton	3	brush	2	Giant Ragweed	1
	Rough Buttonweed	3	Slender		Silverleaf Night-	
	Terragon		Lespedeza	1	shade	1
	Snakeweed	2	Slimflower		Showy Partridge-	
	Daisy Fleabane	1	Scurfpea	1	pea	1
	Horseweed Flea-		Verbena	1	White Crownbeard	1
	bane	1				
	Gaillardia	1				
Grasses	Johnsongrass	2	Little Bluestem	18	Johnsongrass	9
	Little Bluestem	2	Yellow Indian-		Little Bluestem	8
	Scribner		grass	11	Big Bluestem	3
	Panicum	2	Big Bluestem	2	Silver Bluestem	3
	Big Bluestem	1	Johnsongrass	2	Yellow Indian-	
	Brome	1	Scribner		grass	2
	Common Witch-		Panicum	2	Japanese Brome	1
	grass	1	Silver Bluestem	2	Purpletop	1
	Hairy Crabgrass	1	Arrowfeather		Scribner	
	Prairie Threeawn	1	Threeawn	1	Panicum	1
	Sideoats Grama	1	Dropseed	1	Switchgrass	1
			Japanese Brome	1		
			Prairie Threeawn	1		
			Purpletop	1		
		Splitbeard Blue-				
		stem	1			

TABLE XXXI

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT FORAGING PLACES
OF BOBWHITES ON TWO SUPPLEMENTAL STUDY AREAS
(MID-APRIL TO MID-NOVEMBER)

	Lawler Farm		Bottomland	
Trees	Eastern Poplar	1	Black Locust	1
	American Elm	1	American Elm	1
	Hackberry	1		
	Willow	1		
Shrubs	Indigo Amorphia	1		
	Roughleaf Dog- wood	1		
Forbs	Western Ragweed	6	Aster	1
	Terragon Snake- weed	3	American Germander	1
	Louisiana Sage- brush	2	Goldenrod	1
	Dock	1	Western Ragweed	1
	Lambsquarters			
	Goosefoot	1		
Grasses	Johnsongrass	14	Johnsongrass	7
	Little Bluestem	3	Sorghum	4
	Silver Bluestem	2	Barnyardgrass	1
	Dropseed	1	Little Bluestem	1
	Fringeleaf Paspalum	1		
	Hairy Crabgrass	1		
	Purple Lovegrass	1		
	Switchgrass	1		
	Tumble Windmill- grass	1		

TABLE XXXII

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT FORAGING PLACES
OF BOEWHITES ON THE MAIN STUDY AREAS
(MID-NOVEMBER TO MID-APRIL)

	Baucom Farm		Oak Uplands		Bottomland	
Trees			Oak	26	American Elm	13
			American Elm	10	Eastern Black	
			Hackberry	8	Walnut	6
			Eastern Redcedar	5	Hackberry	4
			Woollybucket		Eastern Poplar	3
			Bumelia	2	Eastern Redbud	1
					Eastern Red-	
					cedar	1
					Western Soap-	
					berry	1
				Woollybucket		
				Bumelia	1	
Shrubs	Sumac	2	Sumac	10	Sumac	10
	Chickasaw Plum	1	Coralberry	2	Coralberry	1
Forbs	Goldenweed	3	Western Ragweed	5	-	
	Western Ragweed	2				
	Rough Buttonweed	1				
	Sunflower	1				
Grasses	Hairy Crabgrass	13	Little Bluestem	5	Little Bluestem	7
	Mat Sandbur	8	Johnsongrass	3	Johnsongrass	5
	Prairie Threeawn	4	Prairie Threeawn	3	Yellow Indian-	
	Broadleaf Uniola	1	Yellow Indian-		grass	3
	Dropseed	1	grass	3	Purpletop	1
	Common Witchgrass	1	Silver Bluestem	2	Yellowsedge	
	Fall Panicum	1	Splitbeard Blue-		Bluestem	1
	Fringeleaf		stem	2		
	Paspalum	1	Dropseed	1		
	Johnsongrass	1	Purpletop	1		
	Nimblewill	1				
	Panicum	1				
	Purpletop	1				
Switchgrass	1					

TABLE XXXIII

OBSERVATIONS OF PRINCIPAL PLANTS PROVIDING COVER AT WHISTLING SITES
OF MALE BOBWHITES ON THE MAIN STUDY AREAS

Species or Genus and No. of Observations		
Trees	American Elm	14
	Oak	9
	Hackberry	7
	Mulberry	6
	Common Honey-	
	Locust	1
	Black Locust	2
	Eastern Black	
	Walnut	1
	Eastern Redcedar	1
Shrubs	Smooth Sumac	2
Grasses	Big Bluestem	1

VITA

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