

THE FALL AND WINTER FOOD OF THE BOBWHITE  
QUAIL IN OKLAHOMA

By

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## INTRODUCTION

The bobwhite quail is the most important game bird in Oklahoma, Duck and Fletcher (1944), and certainly more sportsmen of this state hunt quail than any other game species. The statement is made in "Upland Game Birds of Oklahoma" (1948) that about 100,000 hunters take the field each fall in pursuit of the bobwhite. There exists in addition large numbers of people who are deeply interested in the birds from an esthetic point of view. Economically the bobwhite is well on the favorable side, the beneficial food habits of the quail being generally recognized. As a weed seed destroyer and as an arch enemy of insect pests, the bobwhite is probably unsurpassed.

Since continuation of the sport of quail hunting is in a large measure dependent upon wise management of the bird, this study has been undertaken to evaluate the food habits of the bobwhite in Oklahoma with emphasis upon specific determination of its food, variations existing in its geographic range, and by comparison and contrast to provide an aid in proper application of good game management principles to the preservation and increase of the bobwhite.

The bobwhite is found in every county of Oklahoma, being present in varying numbers from McCurtain County in the southeast to Cimarron County in the northwest. Throughout the state the bobwhite seeks its food from the local supply, adapting itself to the surroundings in which it must live. In general the largest numbers of the birds are in the central, northeastern and southeastern sections of Oklahoma.

Food and cover are necessities of life for quail just as they are for any other animal. When food is abundant and cover available quail will thrive if other limiting factors such as hunting, predation, and weather do not take too heavy a toll. In some areas of Oklahoma conditions are favorable enough to produce the optimum number of quail, but in most areas of the state this is not the case. At present the number of quail found on most farms is less than could be provided for if the habitat were improved.

Previous investigations of the foods of the bobwhite in Oklahoma are few and not comprehensive for the state as a whole. Bird (1931) examined 134 crops of quail collected from 19 different counties in Oklahoma. Davison (1936) in his management work on the prairie chicken and quail on the Davison ranch near Arnett, Oklahoma, briefly discusses the food of the bobwhite in that area. Tate (1925) observed that bobwhite quail in the Panhandle took insects and various kinds of weed seeds as food, and Ortenburger (1930) listed the food found in the crops of two bobwhites taken from Harmon County. A more exhaustive study of the food of Oklahoma quail in a restricted area is that of Baumgartner (1945) who examined 168 crops from the Lake Carl Blackwell Project near Stillwater in Payne County, and 37 crops from nearby farm lands in the same county. McMurry (1940) of the U. S. Fish and Wildlife Service began a study on a large collection of crops from various localities in Oklahoma, but unfortunately did not finish the work.

Quail food studies have been made or are in the process of being made in a number of states at the present time. Notable work, which is of in-

terest because of the proximity and similarity to eastern Oklahoma conditions, is that of Korschgen (1948) in Missouri. He examined a very large series of crops from 102 of the 114 counties of Missouri. Other food studies on the food of the bobwhite in neighboring states are those of Chenault (1940) and Warner (1936) in Texas.

Of benefit to anyone interested in the bobwhite in Oklahoma is the game type map of the state, Duck and Fletcher (1943). This map shows in detail the 15 game types of Oklahoma. This same map on a reduced scale has been used to show the types from which samples were received and to illustrate the vast diversity of the topographical and vegetative features of Oklahoma.

This study was begun in September, 1946 as a joint project of the Oklahoma Game and Fish Department and of the Research Foundation of Oklahoma A. and M. College.

#### PROCEDURE

The Oklahoma Game and Fish Department through its rangers and sportsmen cooperators provided the material for examination. Local sportsmen and students at Oklahoma A. and M. College were of great assistance in providing many quail crops from Payne County. The collections for the most part (385 crops) are from the hunting season of 1946 and of 1947. Crops collected in other months (38) are largely from the three months period of January, February, and March, and from the months of late summer and early fall, August, September, and October. Only a small amount of material was available from the spring and summer.





TABLE 1. A STATEWIDE SUMMARY OF THE FOOD OF THE BOBWHITE  
QUAIL IN OKLAHOMA. (BASED ON 385 CROPS)\*\*

FOOD ITEM	% BY VOLUME	% BY OCCURRENCE
Sorghum ( <u>Sorghum vulgare</u> )	17.17	25.45
Ragweed ( <u>Ambrosia psilostachya</u> and <u>Ambrosia artemisifolia</u> )	10.86	35.32
Sunflower ( <u>Helianthus</u> spp.)	7.21	29.61
Korean lespedeza ( <u>Lespedeza stipulacea</u> )	6.68	10.64
Acorns ( <u>Quercus</u> spp.)	6.35	14.80
Johnson grass ( <u>Sorghum halepense</u> )	5.39	17.14
Buckthorn ( <u>Bumelia lanuginosa</u> )	5.11	7.79
Corn ( <u>Zea mays</u> )	3.83	7.79
Little wild bean ( <u>Strophostyles pauciflora</u> )	2.43	20.25
Trailing wild bean ( <u>Strophostyles helvola</u> )	2.26	8.83
Mentzelia ( <u>Mentzelia</u> spp.)	2.20	5.71
Common lespedeza ( <u>Lespedeza striata</u> )	2.06	7.01
Woolly croton ( <u>Croton capitatus</u> )	1.83	15.58
Ash ( <u>Fraxinus</u> spp.)	1.91	6.49
Sumac ( <u>Rhus copalina</u> and <u>Rhus glabra</u> )	1.59	4.15
Sumpweed ( <u>Iva ciliata</u> )	1.43	4.93
Skunkbush ( <u>Rhus trilobata</u> )	1.23	3.63
Snow-on-the-mountain ( <u>Euphorbia marginata</u> )	1.20	8.57
Treebine ( <u>Cissus</u> spp.)	1.17	1.29
Peanut ( <u>Arachis hypogea</u> )	1.06	2.33
Wheat ( <u>Triticum aestivum</u> )	1.05	3.37
Black locust ( <u>Robinia pseudoacacia</u> )	1.04	3.63
Partridgepea ( <u>Chamaecrista fasciculata</u> )	.96	10.38
Vegetative parts; stems, leaves, etc.	.95	36.36
Wild grape ( <u>Vitis</u> spp.)	.95	8.05
Winged pigweed ( <u>Cycloloma striplificifolium</u> )	.82	1.55
Panic grass ( <u>Panicum</u> spp.)	.79	8.57
Dropseed grass ( <u>Sporobolus</u> spp.)	.78	3.37
Tickclover ( <u>Desmodium</u> spp.)	.63	5.19
Giant ragweed ( <u>Ambrosia trifida</u> )	.46	3.89
Deervetch ( <u>Lotus americanus</u> )	.43	3.63
Croton ( <u>Croton</u> spp.)	.42	8.83
Dogwood ( <u>Cornus</u> spp.)	.40	3.37
Chess brome ( <u>Bromus secalinus</u> )	.35	1.29
Blood ragweed ( <u>Ambrosia aptera</u> )	.33	5.19
Day flower ( <u>Commelina</u> spp.)	.32	7.01
Hog peanut ( <u>Amphicarpa</u> spp.)	.26	1.81
Persimmon ( <u>Diospyros virginiana</u> )	.24	.77
Pecan ( <u>Carya illinoensis</u> )	.23	.38
Perilla ( <u>Perilla</u> spp.)	.23	.77
Russianthistle ( <u>Salsola tenuifolia</u> )	.23	2.07

TABLE 1-- Continued

<u>FOOD ITEM</u>	<u>% BY VOLUME</u>	<u>% BY OCCURRENCE</u>
Oseageorange ( <u>Maclura pomifera</u> )	.19	.51
Amaranth ( <u>Amaranthus</u> spp.)	.18	1.81
Knotweed ( <u>Polygonum</u> spp.)	.18	5.19
Toothed euphorbia ( <u>Euphorbia dentata</u> )	.16	.77
Cowpea ( <u>Vigna sinensis</u> )	.16	.51
Sweetclover ( <u>Melilotus</u> spp.)	.14	.77
Oat ( <u>Avena sativa</u> )	.11	1.55
Sand paspalum ( <u>Paspalum stramineum</u> )	.09	5.45
Prairie clover ( <u>Petalostemon</u> spp.)	.08	.77
Groundcherry ( <u>Physalis</u> spp.)	.08	1.29
Lespedeza ( <u>Lespedeza</u> spp.)	.07	6.75
Scurfpea ( <u>Psoralea</u> spp.)	.07	5.45
Poisonoak ( <u>Toxicodendron</u> spp.)	.07	.77
Treadsoftly ( <u>Cnidocolus texanus</u> )	.06	.26
Pink wild bean ( <u>Strophostyles umbellata</u> )	.06	3.12
Golden weed ( <u>Aplopappus</u> spp.)	.05	5.45
Copper leaf, mercury ( <u>Acalypha</u> spp.)	.04	3.11
Hackberry ( <u>Celtis</u> spp.)	.04	2.33
Fall panicum ( <u>Panicum dichotomiflorum</u> )	.04	8.31
Florida paspalum ( <u>Paspalum floridanum</u> )	.04	2.59
Pricklepoppy ( <u>Argemone</u> spp.)	.03	1.29
Bundleflower ( <u>Desmanthus illinoensis</u> )	.03	.51
Paspalum ( <u>Paspalum</u> spp.)	.03	6.75
Queensdelight ( <u>Stillingia sylvatica</u> )	.03	.77
Big sand reed ( <u>Calamovilfa gigantea</u> )	.02	1.29
Eriogonum ( <u>Eriogonum</u> spp.)	.02	1.03
Coralberry ( <u>Symphoricarpos orbiculatus</u> )	.02	2.33
Prairie acacia ( <u>Acacia angustissima</u> )	.01	2.07
Razor sedge ( <u>Scleria</u> spp.)	.01	5.19
Rye ( <u>Secale cereale</u> )	.01	.26
Waterhemp ( <u>Acnida</u> spp.)	-----*	1.29
Bluestem ( <u>Andropogon</u> spp.)	-----	1.29
Threeawn ( <u>Aristida</u> spp.)	-----	.26
Beggarticks ( <u>Bidens</u> spp.)	-----	.77
Catalpa ( <u>Catalpa</u> spp.)	-----	.26
Euphorbia ( <u>Chamaesyce</u> )	-----	1.03
Bittersweet ( <u>Celastrus scandens</u> )	-----	.26
Goosefoot ( <u>Chenopodium</u> spp.)	-----	1.55
Waterhemlock ( <u>Cicuta</u> spp.)	-----	.26
Thistle ( <u>Cirsium</u> spp.)	-----	.51
Spiderflower ( <u>Cleome</u> spp.)	-----	.77
Hawthorn ( <u>Crataegus</u> spp.)	-----	-----
Gourd ( <u>Cucurbita</u> spp.)	-----	.26

TABLE 1-- Continued

FOOD ITEM	% BY VOLUME	% BY OCCURRENCE
Bundleflower ( <u>Desmanthus leptolobus</u> )	----	.26
Buttonweed ( <u>Diodia teres</u> )	----	.51
Lovegrass ( <u>Eragrostis</u> spp.)	----	.51
Flowering spurge ( <u>Euphorbia corollata</u> )	----	.26
Euphorbia ( <u>Euphorbia</u> spp.)	----	.77
Milkpea ( <u>Galactia</u> spp.)	----	----
Gaura ( <u>Gaura</u> spp.)	----	.77
Geranium ( <u>Geranium</u> spp.)	----	3.11
Avens ( <u>Geum</u> spp.)	----	.77
Western indigo ( <u>Indigofera leptosepala</u> )	----	1.55
Indigo ( <u>Indigofera</u> spp.)	----	.77
Stickseed ( <u>Lappula</u> spp.)	----	.77
Purging flax ( <u>Linum catharticum</u> )	----	.26
Wild cucumber ( <u>Malothria</u> spp.)	----	.26
Carpeweed ( <u>Mollugo verticillata</u> )	----	----
Canarygrass ( <u>Phalaris carolinensis</u> )	----	.26
Clammyweed ( <u>Polanisia graveolens</u> )	----	2.07
Hedge cornbine ( <u>Polygonum scandens</u> )	----	1.29
Mock bishopweed ( <u>Ptilimnium</u> spp.)	----	----
Rhubarb ( <u>Rheum raponticum</u> )	----	.26
Sida ( <u>Sida spinosa</u> )	----	.26
Rosinweed ( <u>Silphium</u> spp.)	----	.26
Silverleaf nightshade ( <u>Solanum eleagnifolium</u> )	----	.51
Buffalobur ( <u>Solanum rostratum</u> )	----	.51
Trumpet creeper ( <u>Campsis radicans</u> )	----	1.03
Tovara ( <u>Tovara virginiana</u> )	----	.26
Noseburn ( <u>Tragia</u> spp.)	----	----
Elm ( <u>Ulmus</u> spp.)	----	----
Verbena ( <u>Verbena</u> spp.)	----	.51
Vetch ( <u>Vicia</u> spp.)	----	1.29

Total Plant Food: 96.96

FOOD ITEM	% BY VOLUME	% BY OCCURRENCE
Insects: grasshoppers, beetles, bugs, flies, wasps, bees, katydids, ants, and crickets	1.21	34.54
Insect galls	1.21	1.55
Snails	.09	4.15
Spiders	.04	1.55
Millipedes	----	.51

Total Animal Food: 2.55

TABLE 1-- Continued

FOOD ITEM	% BY VOLUME	% BY OCCURRENCE
Stock feed	.49	.51
Undetermined	-----	1.03
TOTAL MISCELLANEOUS FOOD: .49		

TOTAL FOOD: 100.00

\* FOOD ITEMS OCCURRING IN QUANTITIES LESS THAN 0.01% ARE OMITTED.

\*\*NOMENCLATURE OF PLANT NAMES FOLLOWS STANDARDIZED PLANT NAMES (1942).

TABLE 2. A SUMMARY OF A LIMITED SERIES OF CROPS COLLECTED FROM  
VARIOUS GAME TYPES DURING JANUARY, FEBRUARY, AND MARCH  
(BASED ON 25 CROPS)\*\*\*

FOOD ITEM	% BY VOLUME	% BY OCCURRENCE
Korean lespedeza ( <u>Lespedeza stipulacea</u> )	20.79	24.00
Acorns ( <u>Quercus</u> spp.)	18.92	20.00
Corn ( <u>Zea mays</u> )	8.20	12.00
Ragweed ( <u>Ambrosia psilostachya</u> and <u>Ambrosia artemisifolia</u> )	7.31	24.00
Trailing wild bean ( <u>Strophostyles helvola</u> )	7.12	8.00
Sumac ( <u>Rhus copalina</u> and <u>glabra</u> )	4.33	16.00
Perilla ( <u>Perilla</u> spp.)	4.26	8.00
Buckthorn ( <u>Bumelia lanuginosa</u> )	4.00	-----*
Tickclover ( <u>Desmodium</u> spp.)	4.00	-----
Wild grape ( <u>Vitis</u> spp.)	3.88	16.00
Hawthorn ( <u>Crataegus</u> spp.)	3.42	-----
Little wild bean ( <u>Strophostyles pauciflora</u> )	3.20	8.00
Wheat ( <u>Triticum aestivum</u> )	2.85	-----
Ash ( <u>Fraxinus</u> spp.)	2.17	-----
Vegetative parts; leaves, stem, etc.	1.51	40.00
Chess brome ( <u>Bromus secalinus</u> )	1.33	-----
Sunflower ( <u>Helianthus</u> spp.)	1.10	12.00
Avens ( <u>Geum</u> spp.)	.57	8.00
Coralberry ( <u>Symphoricarpos orbiculatus</u> )	.09	-----
Croton ( <u>Croton</u> spp.)	.01	-----
Poisonoak ( <u>Toxicodendron</u> spp.)	.01	-----
Amaranth ( <u>Amaranthus</u> spp.)	-----**	-----
Giant ragweed ( <u>Ambrosia trifida</u> )	-----	-----
Goldenweed ( <u>Aplopappus</u> spp.)	-----	-----
Hackberry ( <u>Celtis</u> spp.)	-----	-----
Wooly croton ( <u>Croton capitatus</u> )	-----	-----
Snow-on-the-mountain ( <u>Euphorbia marginata</u> )	-----	-----
Geranium ( <u>Geranium</u> spp.)	-----	-----
Common lespedeza ( <u>Lespedeza striata</u> )	-----	-----
Canarygrass ( <u>Phalaris carolinensis</u> )	-----	-----
Groundcherry ( <u>Physalis</u> spp.)	-----	-----
Smartweed ( <u>Polygonum</u> spp.)	-----	-----
Hedge cornbine ( <u>Polygonum scandens</u> )	-----	-----
Pink wild bean ( <u>Strophostyles umbellata</u> )	-----	-----
Total plant food 99.07%		

\* occurrence in only one crop

\*\*less than 0.01% by volume omitted

TABLE 2— Continued

FOOD ITEM	% BY VOLUME	% BY OCCURRENCE
Insects: grasshoppers, beetles, bugs, flies, wasps, katydids, ants, and crickets	.88	20.00
Thousand legs (Millipedes)	.05	----*
Spiders (Arachnids)	----**	----
Insect galls	----	----
Total animal food:		.93
TOTAL FOOD:		100.00

\* occurrence in only one crop

\*\*less than 0.01% by volume omitted

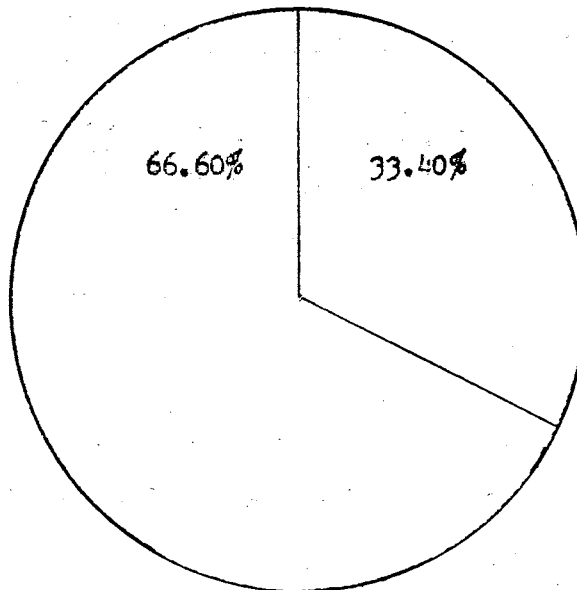
\*\*\*nomenclature of plant names follows Standardized Plant Names (ibid.)

TABLE 3. SOME IMPORTANT FOODS DURING THE MONTHS OF AUGUST,  
SEPTEMBER, AND OCTOBER  
(BASED ON 10 CROPS)

1. Insects
2. Panic grass (Panicum spp.)
3. Wooly Croton (Croton capitatus)
4. Paspalum (Paspalum spp.)
5. Sunflower (Helianthus spp.)
6. Sumac (Rhus glabra and Rhus copalina)
7. Pricklepoppy (Argemone spp.)
8. Russianthistle (Salsola tenuifolia)

TABLE 4. THE TEN MOST IMPORTANT BOBWHITE FOODS DURING THE ENTIRE YEAR IN THE ORDER OF THEIR IMPORTANCE (BASED ON 423 CROPS)

1. Sorghum (Sorghum vulgare)
2. Ragweed (Ambrosia psilostachya and Ambrosia artemisifolia)
3. Sunflower (Helianthus spp.)
4. Korean lespedeza (Lespedeza stipulacea)
5. Acorns (Quercus spp.)
6. Johnson grass (Sorghum halepense)
7. Buckthorn (Bumelia lanuginosa)
8. Corn (Zea mays)
9. Little wild bean (Strophostyles pauciflora)
10. Trailing wild bean (Strophostyles helvola)

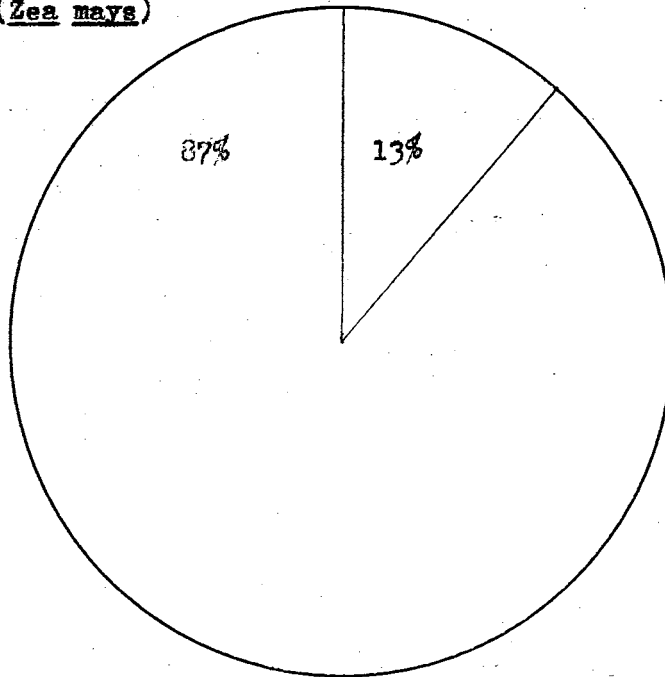


The first ten foods of the bobwhite on a state-wide basis make up 66.60% of the total contents of the gross volume. Miscellaneous minor foods make up the remaining 33.40%.



TABLE 5. THE TEN MOST IMPORTANT FOODS OF THE OAK-HICKORY AND  
OAK-PINE GAME TYPES IN THE ORDER OF THEIR IMPORTANCE  
(BASED ON 35 CROPS)

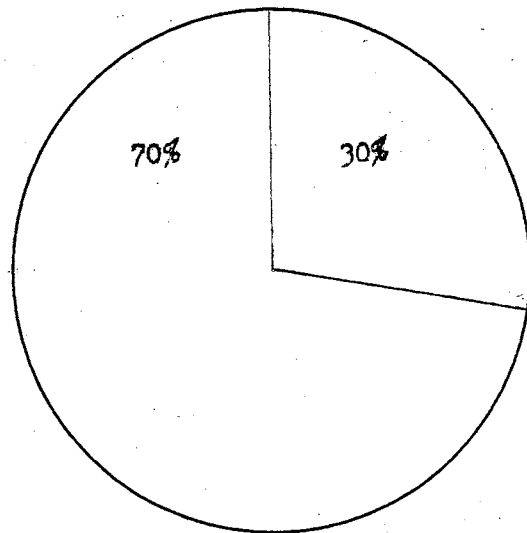
1. Korean lespedeza (Lespedeza stipulacea)
2. Buckthorn (Bumelia lanuginosa)
3. Acorns (Quercus spp.)
4. Treebine (Cissus spp.)
5. Panic grass (Panicum spp.)
6. Common lespedeza (Lespedeza striata)
7. Giant ragweeds (Ambrosia aptera and Ambrosia trifida)
8. Sumac (Rhus copalina and Rhus glabra)
9. Sorghum (Sorghum vulgare)
10. Corn (Zea mays)



The first ten foods of the Oak-Hickory and Oak-Pine types  
make up 87% of the total food. Miscellaneous minor foods make up  
the remaining 13%.

TABLE 6. THE TEN MOST IMPORTANT FOODS OF THE POST OAK-BLACK JACK  
GAME TYPE IN THE ORDER OF THEIR IMPORTANCE  
(BASED ON 126 CROPS)

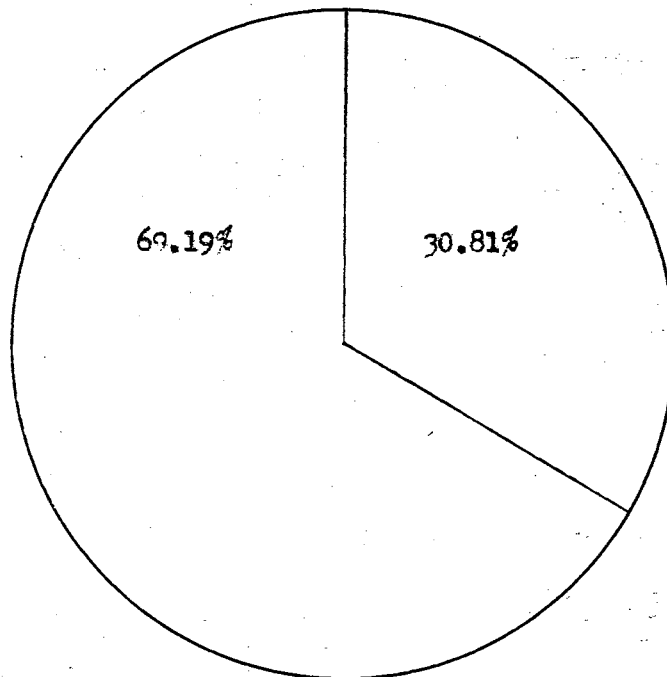
1. Ragweed (Ambrosia psilostachya and Ambrosia artemisifolia)
2. Acorns (Quercus spp.)
3. Sorghum (Sorghum vulgare)
4. Korean lespedeza (Lespedeza stipulacea)
5. Johnson grass (Sorghum halepense)
6. Buckthorn (Bumelia lanuginosa)
7. Corn (Zea mays)
8. Sunflower (Helianthus spp.)
9. Trailing wild bean (Strophostyles helvola)
10. Common lespedeza (Lespedeza striata)



The first ten foods in the Post Oak-Black Jack type  
make up 70.00% of the total. Miscellaneous minor foods make  
up the remaining 30.00%.

TABLE 7. THE TEN MOST IMPORTANT FOODS OF THE TALL GRASS PRAIRIE  
GAME TYPE IN THE ORDER OF THEIR IMPORTANCE  
(BASED ON 153 CROPS)

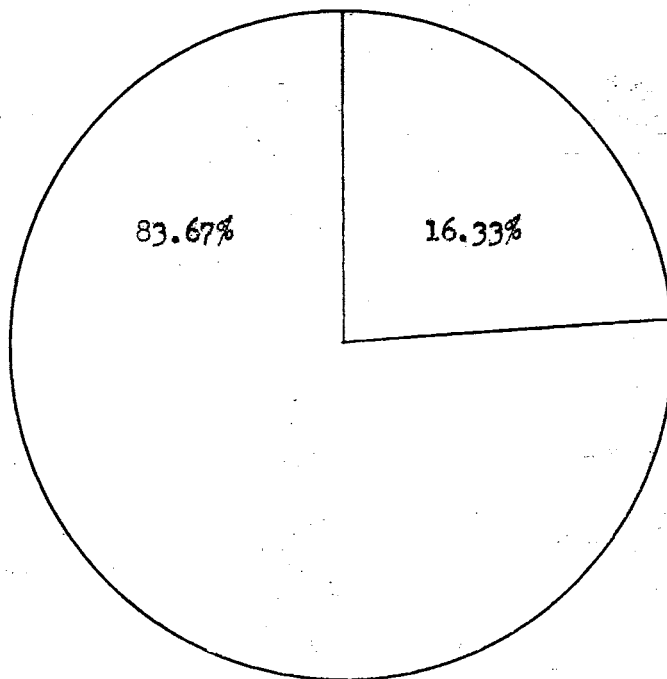
1. Ragweed (Ambrosia psilostachya and Ambrosia artemisifolia)
2. Sorghum (Sorghum vulgare)
3. Sunflower (Helianthus spp.)
4. Corn (Zea mays)
5. Trailing wild bean (Strophostyles helvola)
6. Johnson grass (Sorghum halepense)
7. Acorns (Quercus spp.)
8. Insects
9. Korean lespedeza (Lespedeza stipulacea)
10. Sumpweed (Iva ciliata)



The first ten foods of the Tall Grass Prairie game type make up 69.19% of the total. Miscellaneous minor foods make up the remaining 30.81%.

TABLE 8. THE TEN MOST IMPORTANT FOODS OF THE COMBINED GAME TYPES OF SHORT GRASS PRAIRIE, MIXED GRASS TRODED PLAINS, SHINNEY OAK, STABILIZED DUNE, SAND-SAGE GRASSLAND, AND MESQUITE GRASSLANDS TYPICAL OF WESTERN OKLAHOMA. (BASED ON 77 CROPS)

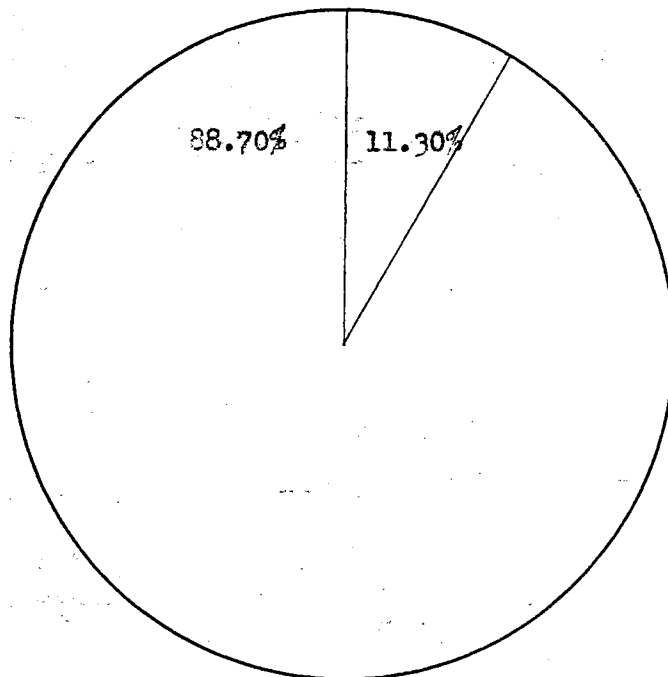
1. Sorghum (Sorghum vulgare)
2. Mentzelia (Mentzelia spp.)
3. Woolly croton (Croton capitatus)
4. Sunflower (Helianthus spp.)
5. Buckthorn (Bumelia lanuginosa)
6. Acorns (Quercus spp.)
7. Insects
8. Dropseed grass (Sporobolus spp.)
9. Wheat (Triticum aestivum)
10. Ragweed (Ambrosia psilostachya and Ambrosia artemisifolia)



The first ten foods of the combined game types of western Oklahoma make up 83.67% of the total. Miscellaneous minor foods make up the remaining 16.33%.

TABLE 9. THE TEN MOST IMPORTANT FOODS FOUND IN THE BOTTOMLAND  
GAME TYPE IN THE ORDER OF THEIR IMPORTANCE  
(BASED ON 33 CROPS)

1. Johnson grass (Sorghum halepense)
2. Skunkbush (Rhus trilobata)
3. Acorns (Quercus spp.)
4. Partridgepea (Chamaecrista fasciculata)
5. Buckthorn (Bumelia lanuginosa)
6. Korean lespedeza (Lespedeza stipulacea)
7. Sumac (Rhus copalina and Rhus glabra)
8. Sumpweed (Iva ciliata)
9. Ragweed (Ambrosia psilostachya and Ambrosia artemisifolia)
10. Sorghum (Sorghum vulgare)



The first ten foods in the Bottomland game type provide 88.70% of the total food. Miscellaneous minor foods make up the remaining 11.30%.

MAP A. THE STATE OF OKLAHOMA DIVIDED INTO THREE MAJOR TOPOGRAPHICAL AND VEGETATIVE DIVISIONS.

Division 1. The Oak-Pine and Oak-Hickory game types with the minor types of the Loblolly Pine and Cypress Bottom included.

Division 2. The great central belt of Post Oak-Black Jack and Tall Grass Prairie game types which produces most of Oklahoma's quail.

Division 3. The diversified combined game types of western Oklahoma consisting of the Stabilized Dune, Shinnery Oak Grassland, Mesquite Grassland, Mixed Grass-Eroded Plain, Short Grass Prairie, and the Sand-Sage Grassland. Quail are locally abundant, but often scarce or absent over large areas.

(See tables 3-9 for the important quail foods in each of the main divisions.)

## DISCUSSION

Major Foods It will be seen in Table 4 on page 11 that the ten most important foods of the quail in Oklahoma make up an aggregate of 66.60% of all foods taken. The wide variety of the bobwhite's food becomes of less significance, however, since a relatively few plant foods make up nearly two-thirds of the total food, even when the state with its very wide botanical diversity is considered as a whole. Fortunately the bobwhite will take and thrive on a large variety of food materials, varying its diet by season and taking advantage of those plant and animal foods occurring in the locality which it inhabits. In general, it may be said that the quail feeds extensively on insects from spring to fall, perhaps an indication of the greater availability and need of a food high in protein content during the breeding season and while the young are developing.

Seasonal Requirements The limited series of summer material examined demonstrates a wide use of the earlier fruiting plants, principally grasses, followed as the season advances into late summer by an increasing intake of the seeds and fruits of those plants maturing in late summer or early fall. The greatest abundance of staple quail foods probably occurs in late fall when the sorghums, sunflowers, and ragweeds, for example, usually become abundant throughout the state. It is probable that quail forced to change their food from their usual staple diet in an area due to a crop failure or pronounced change in soil culture need suffer no inconvenience except in case of very severe weather or other adverse con-

dition. The chance of all the major quail foods in an area failing simultaneously is considered to be rare under average circumstances. A large destructive fire, complete inundation, or radical changes in soil culture might completely remove all or nearly all of the foods in an area, forcing the quail to move or starve. More gradual changes would have the same effect, but spread over a longer period of time. Extreme weather conditions do not necessarily mean a total lack of available food, Baumgartner (ibid.). Even heavy snows do not entirely eliminate food supplies unless they persist for several days and cover the ground so completely that the quail do not have access to their normal food supply. Baumgartner's investigations in the Tall Grass Prairie Game Type indicate a movement of quail to heavily wooded areas, particularly sumac thickets, where they remained until the snow melted. Sumac fruits being persistent and usually above the snow line will provide a source of emergency food, however, from observations on quail in Iowa, Errington (1936) says, "Quail will starve in but a few days time when compelled, in confinement or in the wild, to rely too much for food upon such common and readily eaten winter fruits as those of sumac (Rhus spp.), wild grape (Vitis spp.), bittersweet (Celastrus scandens), and Rose (Rosa spp.)." His observations also demonstrated that under Iowa conditions enough food was always available except under extreme conditions of drought or snow to accommodate the peak of a quail population. Under weather conditions in Oklahoma it is probable that the quail are pressed less severely during such periods than in Iowa. The leanest time of the year for the quail in Oklahoma is during January, February, and March



when competition with other birds and mammals for available food is intensified and coupled with the severest cold weather of the year often reduces the bobwhite to a bare existence level.

The bulk of the crops examined during the course of this study came from collections during the two months of the hunting season, and do not indicate what quail foods are important at all seasons of the year. They do, however, indicate comparative values of different food material by comparisons with the more limited series taken during the three month periods of late winter and early spring, and the late summer and early fall.

The very high percentage of plant food contrasted with animal food during the fall and winter months is to be expected. Results of work done in other states, for example Korschgen (ibid) in Missouri, found that plant foods made up 97.60% of all food taken during November and December. In Oklahoma it was found that 96.96% of the total food taken during these months consisted of foods of vegetable origin, certainly a close similarity to the Missouri results. Allen and Pearson (1945) in a study in Alabama of the summer foods of the bobwhite found that 32% of the crops contents was made up of insects of various kinds, chiefly grasshoppers. This condition is probably true in Oklahoma, since the few summer crops examined showed a high percentage of insects, 27.18% consisting of this food. Stoddard (1936) working in the southeastern states, found 4.48% of the food of the bobwhite on a yearly average consisted of insects and that, as is true in Oklahoma, some insects

are eaten the year round. During the months of April to October inclusive Stoddard (ibid.) found that 21.51% of the food of the bobwhite was of insect material. This percentage compares rather closely with the few crops available from the summer season in this state. He found that the peak of insect use was during the month of October and the lowest consumption in February. Baumgartner (ibid.) found that insects constituted only .95% in the series of fall and winter crops collected from 1939 to 1943 on the Lake Blackwell Project in Payne County.

Green plant food was eaten by the bobwhite all year long, but not often in great quantity. There was a consistent appearance of green vegetable material; seed coats, stems, and leaves in many different quail from all game types. Of all crops examined, 36.36% had quantities varying from a trace to 100% of the contents; however, green material made up only .95% of the food as a whole. It is probable that this green material provides necessary minerals and vitamins. Gorsuch (1934) working on the Gambel quail in Arizona found a distinct correlation of the amount of green food available with the development of the breeding behavior.

Regional Preferences The geographic and botanical differences in Oklahoma are well demonstrated by comparing the food of the bobwhites taken from the three major geographic areas. It is obvious by comparing the list of foods of the quail from each of these three regions, illustrated by the map on page 17, that instead of finding a completely new source of food, the quail in each area tend to depend to a large measure upon the staple foods which are likewise the mainstay of their kind in the other two main divisions.

They must, however, modify their preference to accommodate themselves to the food sources found in the local area. The substitution of such foods and its variability may be shown by comparing two game types that are geographically very different and widely separated. A covey of quail from Delaware County in the Oak-Hickory Game Type of extreme northeastern Oklahoma depends upon Korean lespedeza, buckthorn, and acorns as their principal foods, but a similar covey in Woodward County in the northwest in the Short Grass Prairie Game Type feeds upon sorghum, mentzelia, and croton, which are three of the food plants found abundantly in that area. Each covey then, in a descending order, feeds on the less preferred or less available foods to round out the diet. It is in these minor foods that the greatest variability in the food of Oklahoma quail is usually seen. A comparison of any two of the game type tables, pages 12-17, will demonstrate this point more graphically.

A comparison with investigation of the food habits of quail in Missouri by Korschgen (ibid) shows that in a large measure Oklahoma quail and those of Missouri have similar preferences, particularly Oklahoma quail from the extreme northeastern areas of the state which are in some respects similar to Missouri. The first ten foods of Missouri are Korean lespedeza, corn, ragweed, sorghum, acorns, sassafras, soybeans, beggarticks, little wild beans, and croton in that order. Six of these principal foods are also found to occur in the first ten in Oklahoma, but in a different sequence. The different crop practices in the two states insofar as they are similar and as they differ would be expected to influence strongly the quail food supply. Much more sorghum is grown in

Oklahoma than in Missouri, but less acreage is devoted to soybeans. The comparative value of sassafras in the two areas is apparent, this plant not occurring even as a trace from the Oklahoma quail crops, but ranking sixth in importance in Missouri. These differences are believed to be of minor importance, since the quail will, in nearly all cases, find other staple foods if they are able to exist in the area concerned.

Some food plants are found generally distributed over the United States throughout the range of the bobwhite. In every food study done on the bobwhite with which the writer is familiar, the value of legumes is recognized. The "wild beans" constitute a highly nutritious and much sought after food wherever quail are found, Graham (1941). A few of these are cowpeas, soybeans, wild bean, milkpea, partridgepea, and the peanut. Such plants do not always occur in the same area, but some one or more of them usually do. Oklahoma has plenty of these leguminous plants, western species replacing those that are more plentiful in the states to the east and south.

In Oklahoma it was found that certain plants ranked high in all game types, usually closely following the plant's relative importance as a quail food on a state-wide basis. One however, the small wild bean, although ranking number nine in the state, does not appear in the first ten in any game type. Three food materials are found to have ranked high in every type represented in this study: sorghum, ragweed, and acorns. Two plants--buckthorn and Korean lespedeza--were among the first ten in four of the five major groups, and two--Johnson grass and corn--in three of the groups. The common sunflower and the trailing wild bean were found to rank high

in two of the game types. It is fortunate that such a high proportion of the major quail food plants of the state occur in all or part of the major quail-producing areas.

Management An example of the slow deterioration of a quail range from the food standpoint is the Lake Carl Blackwell Project near Stillwater in north central Oklahoma. Baumgartner (ibid.) found a nearly ideal habitat for quail on this project due to the abandonment of the land involved and the resettlement of the inhabitants elsewhere. The homesteads after abandonment came up to a profuse growth of annual weeds and, together with the crop land which lay fallow, produced a large amount of quail food. Since that time the fields have gradually reverted to the climax growth of bluestem grasses as the dominant vegetation with the gradual elimination of the annual weeds that heretofore made up such a high proportion of the food of the quail in this area. Grassland does not produce as much growth of annual weeds as does land that is disturbed from time to time. Once an area has completely reverted to grassland, the quail can only find sufficient food on the margin of the area or within the area where soil disturbance such as gullying, fires, and overgrazing set the plant succession back to the earlier stages which produce more food for the bobwhite. It is certainly not contended, however, that these three destructive soil practices are necessary for quail to thrive. Conservation farming with strip-cropping, uncut and unburned fence rows, and cover growth in the field corners will no doubt compensate for the loss of some of the annual weed seed production by providing waste grains and weeds occurring in conjunction with such farming.

The application of proper management to any area in Oklahoma by preventing destructive burning, excessive grazing, and unnecessary removal of quail food and cover through clean farming would probably insure a steady availability of food and cover requirements. Under such conditions, the optimum number of quail could probably be readily maintained. In some cases overgrazing and even moderate erosion provide an abundance of weeds which furnish the quail with food. Proper conservation farming practices probably offset the loss of the food provided by these abusive soil practices by replacement food supplies in fence rows and uncut and unburned corners which produce good quail cover without which quail can never exist even in the presence of abundant food. The prevailing agricultural practices in Oklahoma are ordinarily rather good for quail or they would not be here. Certainly land abuse is not to be encouraged. Large numbers of bobwhites in a desolation of unchecked gullies and eroded weed-covered hillsides would be small compensation for the ruination of the land which would destroy not only the quail eventually, but all other animal life as well.

No magic or divine inspiration is necessary to provide quail with food. Sensible habitat improvement has been shown to provide quail food at a minimum cost with a heavy return in more abundant and healthier birds. What is good for the land is also good for the bobwhite.

## SUMMARY AND CONCLUSIONS

A systematic analysis of the food of the bobwhite quail was undertaken through the joint efforts of the Oklahoma Game and Fish Department and the Research Foundation of the Oklahoma A. and M. College.

There are fifteen game types in the state, of which all but four are represented in this study. These four types are small and unimportant as quail habitat. They are the cypress bottom, loblolly pine, pinon pine, and pinon-juniper types.

The analysis was made from crops collected by the rangers of the Game and Fish Department and by sportsmen cooperators. Crops were examined and the statistical work compiled at the Oklahoma A. and M. College.

1. The ten most important quail foods in Oklahoma on a state-wide basis are sorghum, ragweed, sunflowers, Korean lespedeza, acorns, Johnson grass, buckthorn, corn, little wild bean, and trailing wild bean. These foods made up 66.60% of the quail food in 423 crops.

2. A series of crops from the late winter and early spring showed no drastic differences from the hunting season in November and December. Some food of less value as grape seed and sumac are of more importance during this period, probably due to the lack of more preferred foods or to heavy snow cover. The months of January, February, and March are the leanest periods of the year for the bobwhite.

3. An additional series of a limited number of crops from the late summer and early fall--August, September, and October--showed insects to be the most important food at that time of the year, closely followed by the seeds of the panic grasses.

4. The principal foods in each game type varied when compared with the state-wide summary, but only in a minor way. Sorghum, ragweed, and acorns were high in every game type; buckthorn and lespedeza in four of the five groups; Johnson grass and corn in three; and sunflower and the trailing wild bean in two of the game types.

5. The most important foods in the eastern part of Oklahoma are: Korean lespedeza, buckthorn, acorns, treebina, panic grasses, common lespedeza, ragweed, sumac, sorghum, and corn.

6. The important foods in the central section of the state were: ragweeds, acorns, sorghum, Korean lespedeza, Johnson grass, buckthorn, corn, sunflower, trailing wild bean, common lespedeza, sumpweed, and insects.

7. The foods of greatest importance in the combined game types of western Oklahoma are: sorghum, mentzelia, croton, buckthorn, sunflower, acorns, insects, dropseed grass, wheat, and ragweed.

8. The Bottomland game type which is continuous throughout Oklahoma, showed these foods to be important: sorghum, skunkbush, acorns, partridgepea, buckthorn, Korean lespedeza, sumac, sumpweed, and ragweed.

9. Ten major plant foods made up 66.60% of all food taken by the bobwhite. Quail vary their diet widely to accommodate themselves to different surroundings. Insects formed a continuously occurring, but small part of the total food, principally in the summer and early fall. Summer food showed a higher percentage of grass seeds and insects than at other



times of the year. The greatest abundance of quail food appeared to be in early fall. Quail suffer no great inconvenience from lack of available food except during severe cold and heavy snow cover. Changes in soil culture or widespread flood and fire may remove all or nearly all of the food of the bobwhite. Quail will starve if forced to remain on a diet of foods low in nutritive quality. Oklahoma quail are hardest pressed for food during January, February, and March.

Fall and winter food is nearly all of vegetable origin. Green food is taken all year, but infrequently in quantity.

10. Geographic and regional preferences of bobwhites in Oklahoma were apparent throughout the state. Quail depend to a large measure on staple foods preferred by the bobwhite in other regions, but adapt readily to local conditions. Minor foods provide the filler material in quail foods and are widely diverse. Quail of Missouri and northeastern Oklahoma showed some foods in common. Six major foods in the first ten were identical, but occurred in varying order of importance. Quail food plants are generally distributed over the range of the bobwhite in the United States. Legumes are an important and valuable food. The first ten food plants in Oklahoma, with one exception, the small wild bean, occurred in every game type.

11. Good management of quail-producing areas can be developed by providing proper habitat for the bobwhite. Food and cover can be cheaply and rapidly produced by natural methods. Grassland in the Tall Grass Prairie game type is not good quail habitat after it approaches climax

except around the edges of the type or along stream bottoms where soil disturbances encourage the growth of the annual weeds that produce so much of the bobwhite's food. Prevention of burning, excessive grazing, and removal of quail food plants by clean farming, will provide food and cover requirements. In some cases abusive soil practices benefit quail by producing more of the seeds of the annual weeds for food. This practice is not recommended in any quail management. Conservation farming, if properly done, will provide plenty of food and cover for the bobwhite.

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