FOOD HABITS OF BOBWHITE QUAIL DURING JANUARY-MARCH IN SOUTHERN ILLINOIS

GRADY L. BARNES AND W. D. KLIMSTRA
North Carolina Wildlife Resources Commission and Cooperative Wildlife Research Laboratory, Southern Illinois University

ABSTRACT.—Bobwhite quail utilization of food items in winter was determined from 195 crops collected during January through March from southern Illinois. Plant materials comprised 84.2 per cent of the volume and animal matter 15.8 per cent; grit occurred in 12.8% of the crops and 12.3% were empty. Of 81 food items, 11 made up 1.0% or more by volume. These included corn 34.6%, lespedezas 16.1%, slugs 13.7%, soybean 7.2%, oaks 6.7%, sassafras 5.3%, desmodiums 2.7%, common ragweed 2.1%, wheat 2.1%, small wild bean 1.7%, and rushfoil 1.5%. During January, Korean lespedeza ranked first with 40.8% whereas corn ranked first (33.8%) in February and in March (43.6%). Grit occurred in 2.0%, 8.6%, and 24.3% of the crops during January, February, and March, respectively.

This research was conducted to determine foods utilized by bobwhite quail (*Colinus virginianus*) during January through March. It was anticipated that such data would permit an analysis of the effects of environmental conditions, such as weather and land use practices, on the dietary pattern of bobwhites during this season. For comparison, a previous study (Larimer 1960) established similar information for the fall season (November and December).

DESCRIPTION OF AREA

The region of southern Illinois included in this study incorporates the southern 34 counties. However, data to be presented include only nine counties (Massac, Union, Jackson, Williamson, Franklin, Hamilton, Perry, Washington, and Marion) which represent the central and southern portions of southern Illinois. This area is characterized by intermingled prairie conditions from the north, and the Ozark and Shawnee Hills from the south. The northern part, affected by recent glaciers, is level land characterized by a young topography with poor drainage. Most of the southern section, not affected by glaciers, has a hilly topography with serious erosion. According to Leighton, et al. (1948), two physiographic regions, Shawnee Hills Section and Mt. Vernon Hill Country, are represented by those counties where quail were collected.

The Shawnee Hills Section in general coincides with the unglaciated area and is represented by red and yellow podzolic soils (U. S. Department of Agriculture 1938) which are subject to severe erosion, resulting in submarginal and patch-type farming. Most of the bottomlands are composed of clay and are relatively unproductive; however, those originated from alluvial deposits are fertile. Corn, lespedeza, and soybeans are the chief crops, but fruit and vegetable production are important in local areas. Because of the erosible topography, 38 to 68% of cultivatable land is in hay or pasture, with 10% idle (Ross and Case 1956). Forests occupy about 26 to 41% of the land area (King and Winters 1952).

The Mt. Vernon Hill Country comprises the southern portion of the

Illinoisan driftsheet. The major soils are planosols derived from the action of glaciers and loess deposits and formed under the influence of permanently or seasonally poor drainage conditions (U. S. Department of Agriculture 1938). The surface soils are low in fertility and organic matter. Subsoils are heavy, tough, and impervious causing poor drainage and poor drought resistance. Corn and soybeans are the principal crops, with 6-10% of the land idle, 23-29% in pasture, and 17-32% in forest growth.

Three farming regions, General Farming and Dairy, General Farming, and General Farming and Fruit (Ross and Case 1956), were represented in the sample of quail crops collected. In the General Farming and Dairy region, wheat, corn, and soybeans comprise 29%, 13%, and 13%, respectively, of the cultivated land. Twenty percent of the cultivatable land is pasture and 7% idle.

In the General Farming area, erosion and poor soil drainage contribute to the pattern of land use. Corn and soybeans, 19% and 13%, respectively, are the most important crops; idle land comprises 15% and forest land 16 to 25%. The distribution of idle land and forest, plus the production of corn, soybeans, and Korean lespedeza contribute to good quail habitat in this area.

The southern tip of Illinois is the General Farming and Fruit area. As most of this lies within the boundaries of the Shawnee National Forest, woodland comprises 26 to 41% of the land area. Corn (22%) and soybeans (9%) are the important intertilled crops; hay (9%) and pasture (36%) are the main permanent cover crops. The rolling topography of the upland contributes to soil erosion and often results in patch farming that offers excellent quail habitat.

Southern Illinois is characterized by hot summers, mean temperature of 78°F in July, and cool to cold winters, mean temperature of 30°F in January (Page 1949). The average snowfall is approximately 10 inches, with most occurring in January, February, and December. Rainfall averages 40 to 46 inches per year with January, March, and April being the wettest months.

Materials and Methods of Analysis

During January, February, and March 1956, 195 quail crops were collected from 34 individual hunting trips. As trapping methods would require the use of bait that would appear in the crop analyses, quail were collected by regular hunting methods. Field notes, land use, cover utilization, activity and weather conditions, were recorded for each bird. Harvested birds were tagged with such data as date, sex, age, weight, and time of kill and frozen upon return from the hunt.

Identification of various food items were made by utilizing the reference collection of the Cooperative Wildlife Research Laboratory. Unknown seeds were sent to Dr. Alexander Martin, Research Biologist at Patuxent Research Refuge, Laurel, Maryland, for identification. Insect nomenclature was based on Jaques (1947), gastropods after Baker (1939), and plants according to Jones (1950). The Southern Illi-

nois University Statistical Service calculated total volume and frequency of occurrence. Volume of individual food was based on determinations employed by Larimer (1960).

Presentation and Discussion of Data

The 195 crops for winter yielded 81 specific food items of which animal matter comprised 15.8% by volume and plant material 84.2%; 12.3% of the crops contained no food. In comparison, Larimer's (1960) study for fall showed 187 food items in 4606 crops from birds harvested in 34 counties in southern Illinois; 9.5% of the crops were empty. Larimer reported 93.9% plant material by volume and 6.1% animal matter. Differences in number of food items and quantity of plant foods utilized during the two seasons suggest fewer items and more reliance on animal matter in winter. However, the significantly greater number of crops for fall may have an important bearing on the nature of these results. It seems likely that availability of a variety of foods would be reduced in winter but the explanation of a 100% increase in consumption of animal matter is not so readily apparent.

Six plant families, grass (Gramineae), legume (Leguminosae), beech (Fagaceae), laurel (Lauraceae), composite (Compositae), and spurge (Euphorbiaceae), comprised 1.0% or more by volume and accounted for 82.3% of the total quantity of all foods. The grasses ranked first with a combined volume of 37.0% with corn being the major contributor; other grasses were of minor importance. The green leaves of cheat (*Bromus* spp.) and small grain were ingested in small quantities. Noticeably absent were the foxtail grasses (*Setaria* spp.) which during the fall hunting season of 1950 and 1951 comprised 1.0% by volume (Larimer 1960). The seeds of foxtail grasses fall early and are probably not readily available in late winter. The legumes accounted for 30.0% of the volume and yielded the largest number of individual species. Korean lespedeza ranked first, but soybean, small wild bean, and common lespedeza were consumed in relatively large amounts. Legume leaves accounted for a large measure of the green leafy material. The Fagaceae, represented by oaks only, ranked third by volume with 6.7%. Acorns encountered consisted of fragments suggesting that utilization was made of remains left by the feeding activities of other animals. The Lauraceae, ranking fourth with 5.3%, was represented by sassafras only. The abundance of sassafras along fencerows and as an early woodland invader of the fields makes it a rather widely distributed and available food throughout southern Illinois. The composites accounted for 2.1% of the volume with common ragweed being the chief representative. Lanceleafed ragweed (*Ambrosia bidentata*), probably the most common species of this group in southern Illinois, made up only 0.03% of the total volume of all food items. Although this species was widely available, the data suggest that it was rarely utilized in proportion to its availability indicating that it possibly is not acceptable as quail food. The Euphorbiaceae ranked sixth with a per

TABLE 1.—Twenty-four Top-ranking Food Items Taken by Bobwhite Quail During January-March, 1956 Compared to Findings of Larimer (1960) for November-December, 1950 and 1951, Southern Illinois.

Food Item	This Study		Larimer (1960)	
	Percent Frequency of Occurrence	Percent Volume	Percent Frequency of Occurrence	Percent Volume
Corn. *Zea mays*	23.1	34.6	28.9	27.8
Korean and common Lespedezas. *Lespedeza stipulacea* and *striata*	36.8	16.1	42.2	8.7
Slugs. Philomycidae	15.9	13.7	6.9	2.8
Soybeans. *Glycine max*	7.2	7.2	22.1	22.4
Acorns. *Quercus* spp.	5.1	6.7	9.6	7.2
White sassafras. *Sassafras albidum*	6.1	5.3	5.2	3.8
Desmodiums. *Desmodium* spp.	6.7	2.7	12.1	2.9
Common ragweed. *Ambrosia artemisiifolia*	9.7	2.1	26.4	4.6
Wheat. *Triticum aestivum*	3.6	2.1	4.5	5.5
Small wild bean. *Strophostyles leiosperma*	10.8	1.7	12.4	1.0
Rushfoil. *Crotonopsis elliptica*	1.5	1.5	1.7	0.2
Sumacs. *Rhus* spp.	3.6	0.7	1.0	0.05
Partridge pea. *Cassia fasiculata*	6.7	0.7	2.4	0.06
Vetch. *Vicia* sp.	1.0	0.6	0.04	Trace
Horse nettle. *Solanum carolinense*	2.6	0.5	1.4	0.08
Ground beetles. Carabidae	5.1	0.4	4.4	0.2

Food Item	This Study		Larimer (1960)	
	Percent Frequency of Occurrence	Percent Volume	Percent Frequency of Occurrence	Percent Volume
Spiders Arachnida	2.1	0.4	3.3	0.2
Legume leaves Leguminosae	18.5	0.3	....	....
Insect larvae Insecta	2.6	0.3	3.0	0.3
Leafhoppers Cicadellidae	5.6	0.3	3.8	0.2
Amber snails Succinia	5.6	0.2	0.8	0.03
Ants Formicidae	1.5	0.2	3.7	0.2
Stink bugs Pentatomidae	2.0	0.2	2.3	0.2
Bidens *Bidens* spp.	3.0	0.2	18.9	1.4

cent volume of 1.6. Rushfoil accounted for the largest percentage, followed by hogworth (*Croton capitatus*) which contributed a minute quantity.

Twenty-one different animal food items were represented; other than slugs, the majority were of little significance in the total volume (15.8%). Ground-beetles (Carabidae) were the chief insects taken, followed by leaf hoppers (Cicadellidae) and stink-bugs (Pentatomidae), with a percent volume of 0.4, 0.3, and 0.2, respectively. The quantity and occurrence of slugs as a winter food is difficult to explain, as the availability of the insects and other animal life was expected to be limited in winter.

Of the 12.3% of empty crops, several were collected in the morning and also during periods when snow and ice were on the ground, which may have prevented the quail from leaving sheltered areas to feed.

Of 81 specific food items identified, only 11 comprised 1% or more of the total volume (Table 1). Cultivated plants yielded a major portion of the food as six farm crops accounted for 59.6% of the total volume. Corn, the most utilized food by volume (34.6%) and second by frequency of occurrence (23.1%) is the major farm crop grown in southern Illinois; mechanical picking results in considerable waste grain available after harvest. By volume, Larimer (1960) found tha

corn ranked first in the fall food habits of quail (Table 1). Korean and common lespedeza ranked second by volume (16.1%) and first by frequency of occurrence (36.8%). Larimer (1956) found these two lespedezas to rank third volumetrically and first in frequency. These two studies suggest that lespedezas were not only a desired food but were probably readily available. Slugs ranked third by volume (13.7%) and fourth by frequency of occurrence (15.9%); they did not appear during days of deep snow or below freezing temperatures. Larimer (1960) ranked slugs ninth by volume (2.8%) in the fall food habits. Soybean, fourth volumetrically (7.2%) and seventh by frequency of occurrence (7.2%), probably reflects agricultural importance and availability. In the fall foods, soybeans ranked second by volume and fourth by occurrence (Larimer 1960); the rapid deterioration of this food probably accounts for its decreased occurrence in winter. Oaks, ranking fifth by volume (6.7%) and frequency of occurrence (5.1%), occur throughout the study area and were considered readily available to the bobwhites. Larimer found acorns to rank fourth (7.2%) in the fall foods. Sassafras was sixth (5.3%) by volume in the winter and seventh (3.8%) by volume in the fall (Larimer 1960); the percent frequency of occurrence was approximately the same for both seasons. Desmodiums totaled 2.7% by volume in the winter and 2.9% (Larimer 1960) in the fall food habits. These legumes, although not widely abundant, occur generally in woodland and brushy habitats and as a weed associated with fallowed fields following agricultural crops. Common ragweed, ranked eighth (2.1%) by volume and sixth by frequency of occurrence, was abundant in cultivated lands, fallow lands, roadsides, pastures, and newly abandoned fields. In the fall food habits, common ragweed ranked sixth (4.6%) by volume and third by frequency of occurrence (Larimer 1960). Wheat, ranked fifth (5.5%) by Larimer (1960) in the fall food habits, is an important crop of southern Illinois, but yielded only 2.1% of the total food volume in winter. The use of wheat in winter seemingly reflects its general availability as result of weathering. Small wild bean (1.7% by volume), an annual found on dry and sandy soils, was relatively abundant (as indicated by frequency of occurrence, 10.8%) in abandoned fields. Rushfoil, which has a restricted distribution because of its growth requirements, yielded 1.5% by volume. The fall food habits showed wheat, small wild bean, and rushfoil with volumes of 5.5%, 1.0%, and 0.2%, respectively (Larimer 1960). Legume leaves had a frequency of occurrence of 18.5%, ranking third by occurrence, but had a percent volume of only 0.3%; these were not recorded in the fall diet.

Food Utilization by Months. Of 36 food items taken by the 51 quail collected in January, only 9 provided a volume greater than 1.0% (Table 2). Korean lespedeza, corn, and soybean were the most prevalent foods; sumacs and horse nettle were consumed only in January which probably reflects the effect of snow on the dietary pattern. The utilization of animal matter during January was the lowest recorded for the 3 months,

TABLE 2.—Comparison by Months of Principal Food Items Consumed by Quail During January, February, and March, Southern Illinois, 1956.

Food Items	January (51 crops)	February (70 crops)	March (74 crops)
	Per Cent Volume	Per Cent Volume	Per Cent Volume
Corn	27.8	33.8	43.6
Korean lespedeza	40.8	1.0	1.5
Soybean	16.8	3.0	0.9
White sassafras	3.5	9.9	2.0
Slugs	2.5	21.0	18.3
Wheat	1.3	0.4	5.0
Desmodiums	1.0	0.2	7.7
Common ragweed	0.9	0.8	5.1
Small wild bean	0.3	3.8	0.9
Vetch	0.0	0.0	2.0
Sumacs	2.1	0.0	0.0
Horse nettle	1.4	0.0	0.0
Partridge pea	0.1	0.0	2.2
Oaks	0.0	16.2	3.1
Rushfoil	0.0	4.1	0.0
All other food items	1.7	5.9	7.7
Grit (percent frequency)	2.0	8.6	24.3
Empty (percent frequency)	13.7	11.4	12.2

probably due to weather conditions; slugs yielded only 2.5% of the volume. Grit was recorded in 2.0%; 13.7% of the crops were empty.

During February, 51 food items were consumed by 70 birds collected, with corn, slugs, and acorns ranking highest (Table 2). Acorns which ranked third in February were not present in January. Korean lespedeza dropped from 40.8% in January to 1.0% in February. Rushfoil was not present in January but ranked fifth in February. Animal matter accounted for a larger percentage of the February foods with slugs alone yielding 21.0%. Grit had a percent frequency of 8.6 compared to 2.0 in January. Empty crops had a frequency similar to that in January.

Of the 59 food items consumed by 74 quail collected in March, 11 had a volume of over 1.0% (Table 2). Corn, slugs, and desmodiums were the most commonly used. Desmodiums, common ragweed, and wheat were more important in March than either January or February. Korean lespedeza, which ranked first in January, fell to eighth place in February and tenth in March. The use of the more perishable foods such as soybeans and small wild beans declined considerably in March. More crops contained grit in March than either January or February; empty crops had a percent frequency of 12.2%.

Food items consumed during each month seem to show a general trend of food availability. As the season

progressed, availability of quail foods change from general abundance and many varieties in the fall (Larimer 1960) to scarcity and few varieties in late winter. Climatic conditions may alter the pattern of food availability and result in a forced change in the quail diet. Also, seeds with thin seed coats will deteriorate and become less abundant than the seeds with hard coats (Bookhout 1954). Those seeds that tend to fall to the ground early will not be as available as those that fall gradually over longer periods of time. A larger percentage of the crops collected in January were collected during days when the snow was on the ground; thus, the amounts and kinds of food items consumed were affected by more adverse weather conditions than those of February and March.

Average weights of birds decreased as the winter progressed, dropping from 180 grams in January to 177 in February and to 170 grams in March. The average weight for the combined period of January to March was 175 grams. Such weight losses may have reflected the availability as well as the quality of foods.

Food Utilization According to Soil Regions. Quail crops were collected from two major soil regions, the planosols and the red and yellow podzolic soils. The planosols were represented by 131 crops from seven counties and the red and yellow podzolic soils by 64 crops from two counties. Except for a variation in the number of seeds of individual plant foods, there appeared to be little difference in the kinds of foods (Table 3). This was similar to that

TABLE 3.—Comparison of the Dietary Pattern of Bobwhite Quail From Planosols and Red and Yellow Podzolic Soils, Southern Illinois, 1956.

Food Items	Planosols (131 crops)	Red & Yellow Podzolic (64 crops)
	Percent Volume	Percent Volume
Corn	39.3	21.1
Korean lespedeza	13.7	19.1
Slugs	9.1	27.0
Soybean	8.8	2.6
White sassafras	6.8	1.2
Oaks	5.0	11.8
Desmodiums	3.6	0.0
Common ragweed	2.6	0.6
Small wild bean	2.2	0.5
Rushfoil	2.0	0.0
Sumacs	1.0	0.0
Wheat	0.8	3.7
Vetch	0.0	2.2
Ground beetles	0.2	1.0
All other food items	5.1	9.6
Grit (percent frequency)	12.2	14.1
Empty (percent frequency)	10.7	15.6

reported by Korschgen (1952) for quail from different soil regions in Missouri. For the red and yellow podzolic soils in southern Illinois, slugs ranked first with corn and Korean lespedeza second and third, respectively. In crops from the planosols, corn ranked first, followed by Korean lespedeza and slugs. More wheat and less soybeans were noted from the red and yellow podzolic than from the planosols. Vetch occurred in the podzolic region but was absent from the planosol region, while desmodiums and rushfoil which ranked among the top ten food items in the planosol area were not recorded from the red and yellow podzolic region. This was probably due to the greater abundance of the latter two plants in fallow and idle land of the planosol region making it more available than in the red and yellow podzolic area. Quail collected from the red and yellow podzolic region had an average weight of 176 grams while those from the planosols averaged 1 gram less.

Food Utilization According to Sex and Age. The sex ratio of the available sample of birds was 52.8% females and 47.2% males. Young birds showed 54.3% females and adults 45.7%. The juvenile birds made up 84.0% of the total sample.

A comparison of foods utilized by adults and juveniles showed some variation but no really significant difference. A comparison of food habits of males and females revealed some difference between the sexes. Slugs and sumacs yielded 22.7% and 1.7%, respectively, of the volume for males; only 7.9% and 0.1%, respectively, were recorded for females. White sassafras showed 8.1% for females and 1.2% for males. Theoretically, because a covey acts as a group there should have been few differences in food items consumed by males and females. There is the possibility that female quail in preparation for egg-laying were stimulated to alter their diet.

No apparent difference in weight was noted between the males or females, nor between adults and juveniles. The average weight for females was 174 grams, for males 175 grams, for adults 176 grams, and for juveniles 175 grams.

Food Utilization According to Time of Kill. Of the total, 100 birds were collected in the morning and 95 in the afternoon. Analyses indicate no great difference in the foods consumed by quail collected in the morning as compared with those killed in the afternoon, although some exceptions were noted. Desmodiums showed 5.1% for the afternoon and 0.1% for the morning. Soybean, corn, and common ragweed ranked higher in the morning, while Korean lespedeza, oaks, rushfoil, vetch, and partridge pea were significantly higher in the afternoon. There seems to be no logical reason to explain this pattern of food utilization. Quail killed in the morning weighed 176 grams—3 grams more than the birds killed in the afternoon (173 gm).

Food Utilization and Weather. The temperature in southern Illinois was below average for January 1956. On January 19th a cold wave moved into the southern part of the State and continued through the remainder of the month (U. S. Department of Commerce 1956). Several inches of snow fell on January 18th an

TABLE 4.—Comparison of the Dietary Pattern of Bobwhite Quail Collected During January When Snow was 3 inches in Depth and When Snow was 3 inches or less in Depth, Southern Illinois, 1956.

Food Items	Over 3 Inches of Snow (21 crops)	Under 3 Inches or no Snow (30 crops)
	Percent Volume	Percent Volume
Soybeans	56.3	0.0
Corn	30.1	26.9
Sumacs	6.5	0.2
Horse nettle	4.8	0.0
Korean lespedeza	1.2	57.6
Sweet clover (*Melilotus alba*)	0.3	0.0
Legume leaves	0.3	0.5
White avens (*Geum canadense*)	0.2	0.0
White sassafras	0.0	5.0
Slugs	0.0	3.6
Wheat	0.0	1.9
Desmodium	0.0	1.4
Common ragweed	0.0	1.3
All other food items	0.4	1.8
Grit (percent frequency)	0.0	3.3
Empty (percent frequency)	28.6	3.3

19th and was followed by a moderate snowfall on the 29th. There was a greater total snowfall in January than in any other January since 1945; although, the total depth at any one time never exceeded 6 inches. As January was considered to be the only month with sufficient snowfall and low temperatures to possibly alter the quail food habits, it was selected as a representative to evaluate the effect of snow and freezing temperatures on food utilization.

Crops for January were divided into two groups according to whether they were collected when the snow was over 3 inches in depth and 3 inches or less (Table 4). Three inches was chosen arbitrarily as a depth that would sufficiently cover seeds on the ground so as to alter quail food patterns. As deep snows tend to cover seeds that lie on or close to the ground, availability of certain foods is probably restricted and quail have less variety as well as quantity from which to obtain their dietary needs.

A change in the quail dietary pattern was noted when snow was on the ground. Comparison of food items consumed during days when the snow was over 3 inches and days when there was less than 3 inches of snow, revealed that soybean, sumacs, and horse nettle were more heavily used when snow covered the ground (Table 4). These species tend to stand above the snow and thus probably were more available to the birds. Also, the seed pods and seeds remained on these plants and were not covered by the snow. During the study, the only time horse nettle and

sumacs were taken in any quantity was when snow was on the ground, thus they might be classed as starvation foods. Damon (1949) reported that quail starved to death after a heavy snowfall even though crops of dead birds were filled with sumac seeds. Field observations during this study showed that quail were feeding in sumac thickets in addition to standing soybeans and stubble around the edge of harvested fields. In the fall Larimer (1960) found that soybean, cowpea, and purple meadow rue were utilized more heavily during periods of deep snow.

The utilization of Korean lespedeza dropped from 57.6% by volume to 1.2% during "snow days". White sassafras ranked third in January during "no snow days", but was not present in any crops during periods of deep snow. Corn appeared rather constant and ranked second during both conditions of snowfall. The mechanical harvesters apparently left some corn that was available above the level of the snow.

Twenty-one crops collected in January when the snow was over 3 inches in depth revealed only 16 different species in comparison to 28 species from 30 crops during the same month when there was less than 3 inches. No animal matter or grit was consumed during periods of deep snow; slugs ranked fourth in January when there was 3 inches or less of snow. Empty crops had a 28.6% frequency of occurrence for "snow days" compared to 3.3% for days with little or no snow. This occurrence of empty crops, plus the fact that quail lost weight during periods of snow, would indicate that excessive snowfall is a critical problem in the existence of quail. Quail collected when the snow was over 3 inches deep averaged 174 grams during January, while those taken when the snow was less than 3 inches, averaged 184 grams. These data suggest that the manipulation of factors to increase the abundance of suitable plants to provide food during deep snow would enhance the survival of quail.

Quail crops were analyzed according to whether they were collected during days with temperatures above or below 32° F. January was used as a representative as it was the only month with a sufficient number days with average temperatures below freezing. As snowfall and low temperatures were closely allied, the dietary pattern during low temperatures tended to reflect the same foods as those utilized when snow depth was 3 inches or more.

During the days that had an average temperature above freezing, volumetrically, Korean lespedeza (49.8%) ranked first, followed by corn (31.6%), white sassafras (6.3%), and slugs (4.5%). For the period of freezing temperatures, soybean (38.6%) ranked first with Korean lespedeza (29.1%) and corn (22.9%) second and third, respectively; sumacs (4.5%) and horse nettle (3.2%) were fourth and fifth. It could not be determined whether sumacs and horse nettle were utilized because of the low temperatures or because days of low temperature and snowfall were closely synchronized. Korean lespedeza showed considerable variation in utilization during above (49.8%) and below (29.1%) freezing temperatures; however

there was not so great a difference as between periods of snow (57.6%) and no snow (1.2%). No animal matter except an occasional insect larvae (.3%) was consumed during periods of intense cold. Empty crops showed a 20.6% frequency of occurrence during freezing temperatures, compared to no empty crops during above freezing temperatures; empty crops may reflect snowfall or they might point out the fact that quail do not move to feed as early or as much on cold days. There was a slight difference in weight between birds collected during periods of below freezing weather (179 grams) compared with those obtained during above freezing weather (181 grams). This difference could either reflect snow fall or empty crops where birds did not feed as readily or regularly during cold weather.

Food Utilization and Land Use. In an effort to determine the extent to which the food habits of quail were associated with land use practices, an attempt was made to classify quail crops as being representative of either cultivated land, wasteland, or mixed farmland. Because the exact range of any one covey was not known, the basis for classification was determined by where quail were harvested. If a bird was obtained in cultivated fields, fencerows or other areas associated with farming practices, the birds were considered as representative of cultivated land. Birds killed on land where there was

TABLE 5.—Comparison of Food Items Occurring in the Crops of Bobwhite Quail Collected From Cultivated Land, Wasteland, and Mixed Farmland, January-March, Southern Illinois, 1956.

Food Items	Cultivated Land (131 crops)	Wasteland (42 crops)	Mixed Farmland (17 crops)
	Percent Volume	Percent Volume	Percent Volume
Corn	38.9	18.0	49.5
Slugs	13.7	14.2	15.4
Soybean	10.8	1.2	0.0
Korean lespedeza	8.0	32.7	22.4
White sassafras	5.7	2.6	9.7
Oaks	5.2	6.8	0.0
Desmodiums	5.2	6.8	0.0
Common ragweed	2.9	1.1	0.0
Wheat	2.6	1.7	0.0
Small wild bean	2.3	0.6	0.4
Sumacs	1.1	0.2	0.0
Rushfoil	0.0	6.5	0.0
Partridge pea	0.0	3.0	0.0
Ground beetles	0.2	1.2	0.0
Spiders	0.0	1.1	0.9
All other food items	4.6	9.2	1.3
Grit (percent frequency)	11.5	11.9	0.0
Empty (percent frequency)	13.7	4.8	0.0

no evidence of farming practices in the general area, such as wasteland, abandoned fields, or woodlands, were recorded as being from wasteland. Quail collected in wasteland associated with cultivated fields were classified as coming from mixed farmland.

In cultivated lands where corn ranked first, slugs second, and soybean third (Table 5), 11 items made up more than 1.0% of the diet. Crops from the wasteland area revealed 13 items with a volume greater than 1.0%; of these Korean lespedeza, corn, slugs, oaks, and rushfoil were the more abundant items. In the mixed farmland, crops (17) were probably insufficient to determine with certainty the food pattern; however, corn, Korean lespedeza, slugs, and white sassafras were the only food items that had a volume greater than 1.0%.

Of the 11 items occurring in crops from cultivated land, desmodiums, small wild bean, and sumacs did not rank in the top items in the wasteland area (Table 5). According to Bookout (1954) desmodiums were associated with plowed lands, while sumacs were associated with permanent cover such as wasteland. Small wild bean was found more frequently in idle lands. Thus it would seem that sumacs and small wild bean should have been more utilized in wasteland areas; as previously pointed out, the use of sumacs was associated with snowfall. Of the 13 top food items utilized by quail from wasteland, rushfoil, common lespedeza, partridge pea, ground beetles, and spiders were the only foods not represented in volumes over 1.0% in crops from cultivated areas. Rushfoil, lespedezas and partridge pea are normally associated with abandoned land. Ground beetle and spiders could be associated with either but might be expected to occur in wasteland in larger numbers.

It can be concluded from the data that quail depend heavily, regardless of the habitat, upon cultivated crops for their subsistence as corn ranked high as a food item in all categories of land use (Table 5). Soybean occurred over 1.0% by volume in cultivated and wasteland groups. Due to modern farming operations considerable waste grain remained in the fields and was readily available. As feeding habits of quail were governed by what was available, cultivated seeds associated with adequate cover were frequently used. Korean lespedeza, although grown for hay and pasture, was usually associated with wasteland because of its persistence and ability to spread. Whether birds were utilizing the wasteland as dependable sources of food or as cover was not established. In some areas, doubtlessly quail depended on wasteland for cover and probably subsisted on no cultivated foods. But, where cultivated crops occur within the cruising radius of a quail covey, these crops were probably consumed in relationship to their availability.

A slight difference was noted in the weight of birds from different land use areas. Quail from cultivated lands averaged 2 grams heavier than those from wasteland, while birds from mixed and wasteland averaged 7 grams heavier than those from cultivated lands. This would indicate that cultivated and waste land intermingled offers better environment for quail.

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