WINTER FOODS OF THE BOBWHITE QUAIL (COLINUS VIRGINIANUS) AT THE FORT CAMPBELL MILITARY RESERVATION

EWING DOUGLAS BUCKNER

To the Graduate Council:

I am submitting herewith a thesis written by Ewing Douglas Buckner entitled "Winter Foods of the Bobwhite Quail (Colinus virginianus) at the Fort Campbell Military Reservation." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in biology.

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WINTER FOODS OF THE BOBWHITE QUAIL (COLINUS VIRGINIANUS) AT THE FORT CAMPBELL MILITARY RESERVATION

An Abstract

Presented to

the Graduate Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements of the Degree

Master of Science

in Biology

by

Ewing Douglas Buckner

August, 1970

ABSTRACT

The bobwhite quail (Colinus virginianus) is an important upland game species. Information concerning the management of this bird is always of importance to wildlife managers.

Many food studies have been made of this bird throughout its range. However, no research prior to the present study has been conducted concerning food habits of the bobwhite quail at the Fort Campbell Military Reservation, Fort Campbell, Kentucky.

During the 1968 bobwhite quail hunting season at Fort Campbell (November 27, 1968 through January 31, 1969) a study was conducted of the bobwhite quail on this reservation. Data were collected concerning winter food habits, sex ratio and age distribution.

The results of the study indicate that Korean and Japanese lespedezas were the most utilized food types. The sex ratio was normal according to Stoddard (1931) and the age distribution indicated the population to be productive according to Odum (1954).

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The author wishes to express special thanks to Captain Arnold Lowder, United States Air Force Weather Station, Fort Campbell, Kentucky who provided the weather data used in the study.

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CHAPTER I

INTRODUCTION

The bobwhite quail (Colinus virginianus) is an important, upland game species. Information concerning the management of this bird is always of interest to the game biologist.

Extensive studies have been done on the bobwhite quail variously throughout its range. Among these are: Stoddard (1931), Gray (1940), Cady (1944), Allen and Pearson (1945), Lee (1948), Korschgen (1952) and Larimer (1960). However, investigations of the bobwhite quail at Fort Campbell, Kentucky have been somewhat limited in nature and largely concerned with short-term remedial action on local areas. It was felt that an investigation such as the present study would assist in making decisions concerning short-term quail management procedures and would provide a basis for future, more extensive studies concerning this important upland game bird.

During the 1968 bobwhite quail hunting season at Fort Campbell, Kentucky (November 27, 1968 through January 31, 1969) a study was made of the bobwhite quail population of this area. The purpose of this study was to determine the different types and amount of foods utilized by the quail and to evaluate certain ecological factors such as weather conditions, plant succession and management techniques that might influence the food selection and utilization. Although the primary concern of this study was the winter foods utilized by the quail, the age distribution and sex ratio were also determined. This latter information could be used later by other investigators on an annual basis to indicate changes in the status of the population.

CHAPTER II

DESCRIPTION OF STUDY AREA

The Fort Campbell, Kentucky Military Reservation consists of approximately 105,000 acres, of which 80,000 acres are open to hunting. The reservation is located on the northwestern portion of the Highland Rim, on the Kentucky-Tennessee border, eight miles north of Clarksville, Tennessee, and sixteen miles south of Hopkinsville, Kentucky. The reservation is bordered on the south by U. S. Highway number 79; on the east by U. S. Highway number 41; on the west by Tennessee Highway number 120 and Kentucky Highway number 139; and on the north by Kentucky Highways number 164, 107 and 117. The reservation makes up portions of Stewart and Montgomery Counties in Tennessee and portions of Trigg and Christian Counties in Kentucky. (Figure 1)

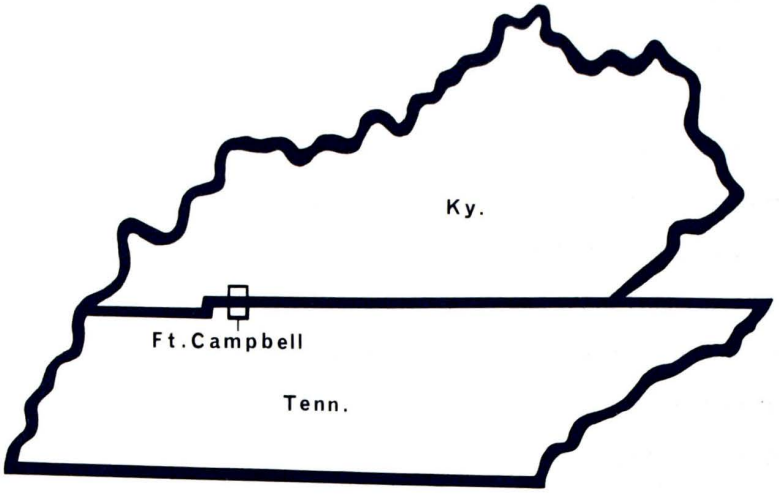
According to Braun (1950) this area is in the Western Mesophytic Forest which has a predominance of oaks (Quercus spp.) and hickories (Carya spp.). However, according to Scott (1964) a reforestation program was initiated on the reservation in 1954. At the present date approximately 35,000 acres are planted in loblolly pine (Pinus taeda) plantations. Approximately 27,000 acres of the reservation are covered by second growth hardwood forests, occurring mainly in small, widely scattered blocks two to forty acres in size.

The topography of the reservation is generally flat and rolling in the central portion, gradually becoming more broken in the western and eastern portions. Some sections of the reservation could be classified as prairie barrens or relics. These, according to Braun (1950), are floristically similar to the prairies of the middle west. Dominants in such a region include post oak (Quercus stellata), black jack oak (Q. marilandica), red oak (Q. falcata), hickory (Carya spp.), hazel nut (Corylus spp.), dogwood (Cornus spp.), gum (Nyssa spp.), sumac (Rhus spp.), and broomsedge (Andropogon spp.)

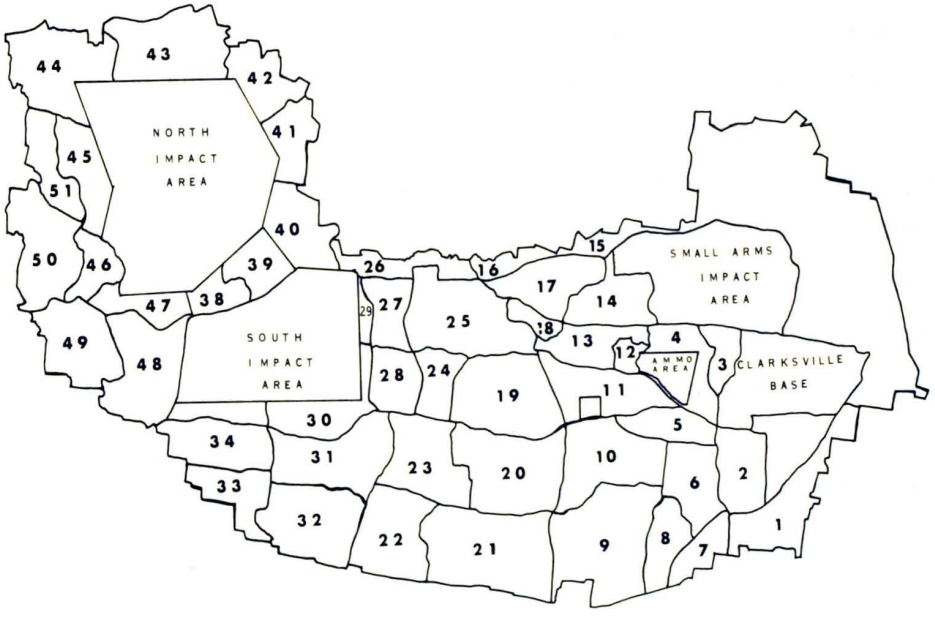
According to Scott (1958), the soils are generally of limestone derivation consisting of Hagerstown, Baxter, and Decatur series. These are among the best agricultural soils in this region. Prior to the acquisition of the land by the Army in 1940 and 1941, the land was used for the production of corn, tobacco and small grains. At the time of acquisition of the land all intensive agricultural practices ceased. Consequently, the land grew up into "old fields" which for the first few years provided excellent food and cover for many game species, including the bobwhite quail. The reservation was first opened to hunting in 1945. Because of such a high hunter success, Fort Campbell became one of the leading quail hunting areas in the United States.

Previous Management Practices

The 80,000 acre reservation is divided into fifty-one similar tracts of land called "areas". Each area is given a number, 1-51. Each area is managed as a separate unit. For the first few years after the



(A)



(B)

FIGURE 1

(A) Geographic Location of the Fort Campbell Military Reservation

(B) Map of the Fort Campbell Military Reservation Showing Areas as They are Presently Numbered

formation of the reservation there was little need for habitat management since the area was originally made up of small farms which provided many fence rows and small fields. These provided much "edge"; consequently, a large area of suitable habitat. However, due to plant succession, the amount of food and cover vegetation gave way to Andropogon spp. and woody species. This situation continued until 1953 quail season when only 5,000 were harvested. The reservation, according to Scott (1958), was over grown to such an extent that it was difficult to train troops in the field and there was such a build up of fuel (dead and decaying vegetation) that damaging wildfires were a serious threat to the timber and wildlife. Because of these and other land use problems the first Forestry Branch was established at Fort Campbell, Kentucky. This branch established a burning program which accomplishes all three of its objectives; (1) it maintains the desired seral stage of vegetation which is suitable for the production of food and cover, (2) the area is suitable for the training of military personnel and (3) prevents the accumulation of large quantities of fuel in the old fields.

Scott (1958) states that 20,000 acres are prepared and burned each year. The fires are set by torches mounted on tractors. The fires are kept under control by the use of back fires and plowed fire breaks. The burned area is usually surrounded by roads. According to Scott (1958) there was a definite increase in the number of quail killed in the burned areas as compared to the areas not burned. In the 1957 quail hunting season there was a total of 15,231 quail killed.

Scott (1958) indicates that prescribed burning reduces dense stands of Andropogon spp. Burning creates openings in these dense stands of vegetation, thereby enabling quail to move freely and at the same time provides a more suitable quail habitat. Fire-induced quail food plants such as patridge pea (Chamaecrista spp.), Korean lespedeza (Lespedeza striata), tick trefoil (Desmodium spp.), ragweed (Ambrosia spp.) and wild bean (Strophostyles spp.) often come back in good stands following prescribed burning operations.

Seeding programs sponsored by the Fort Campbell Rod and Gun Club and the Post Engineers Forestry Section were responsible for the sowing of tons of Korean lespedeza and some corn, milo and millet in accelerated programs.

The Rod and Gun Club also sponsors an annual stocking program in the early spring (March). Hundreds of pen reared quail are released in a limited number of designated areas. The soundness of such a management practice is questionable since only a few such quail survive until the hunting season or mate, because these quail are usually less vigorous and less competitive than "wild" quail.

Hunting regulations on the reservation conform with those of the two adjoining states; Tennessee and Kentucky. The hunting season opens on the latest date of the two states and closes on the earliest. The smallest bag limit of the two states is used.

A checking station manned by the military police is located on the reservation in which each hunting party is assigned a hunting area. This prevents hunters from becoming too concentrated in one area. Each party is required to check in and out at this station and report its kill and other data; number of coveys flushed, number of male and female quail killed, and number of quail downed but not recovered.

Findings of Richardson (1969) suggested that the quail population on the reservation did not differ greatly from the area sampled in Montgomery County, Tennessee. Neither area indicated a decided advantage for the production of quail. These conclusions were the result of a call count census conducted in the Spring of 1969. The area censused on the reservation included those "areas" managed by the Rod and Gun Club and the Post Forestry Division.

CHAPTER III

METHODS AND MATERIALS

The data were collected from quail which were examined by the writer in the Rear Area Military Police Station. The quail were selected at random and examined with the permission of the hunters. An attempt was made to check the kills at least once a week. Facilities were provided at the checking station and as the hunters checked in they were asked to have some of their quail examined. Each bird examined was given a number and a record was made in a small notebook as to the sex, date killed and number of area in which killed. One wing was removed and a number attached to the wing by means of an adhesive label. Care was taken to select the wing which had not had the primary feathers damaged by shot or dogs. The numbered wing was placed in a small plastic bag. Finally, the crop was removed from the bird. Care was taken not to break the crop open. First the crop was located with the fingers. Then the feathers were parted to reveal the skin covering the crop. This skin was picked up and pulled open revealing the crop. The skin was then separated from the crop. The crop was carefully separated from the breast. The esophagus was cut above and below the crop. The result was a small, closed sac filled with the quail's last meal. The crop was then placed in a small specimen jar which had a corresponding number on the top and side. The numbers were written on gummed labels with India ink and then placed in the jar. This label was then covered with cellophane tape for added protection. Data recorded in this manner enable one to determine for each quail the area in which it was killed, the age of the quail, the sex, what it had been eating, and the date it was killed.

The specimens and data were brought back to Austin Peay State University. The numbered wings were frozen in the plastic bag for later evaluation. The specimen jars containing the crops were removed from the carrying case and the lids removed. They were placed on a table near a heater for drying. The crops were allowed to dry until time for them to be analyzed. Davidson (1949) found dried fruits, leaves, seeds, and insects in the crops of game birds remained in good condition for months and even years. The data in the field notebook were then transferred to a ledger for a permanent record.

Aging

The wings of the bobwhite quail are used universally in age determination. The characteristics used for aging were the pointedness of the outer two primaries, the presence or absence of buff tips on the primary converts, and the sleekness of the seventh primary covert. By using these three characteristics in aging quail, the degree of error is small according to Haugen (1957). Generally the

outer two primaries and the buff on the tips of the primary coverts are sufficient to classify the quail as either juvenile or adult; however, for determining the age where these characteristics were not clear, the shape and sleekness of the seventh primary covert was used, as reported by Haugen (1957).

According to Taber (1963) a juvenile quail (less than one year old) is characterized by pointed primaries number nine and ten, buff markings on the tips of the primary coverts and the seventh primary covert is ragged in appearance. In the adult (in its second year or older) the outer two primaries, numbers nine and ten are more rounded, the primary coverts are a uniform dark gray color without any buff brown tipping; however some adult birds have this brown on the tips of the primaries. Taber (1963) considers these markings hereditary. If the brown is present on the primaries it is usually present on the primary coverts, regardless of the age of the quail. In this case the seventh primary covert is used. The seventh primary covert is sleeker in the adult and has more whitish downy tipping on the basal fifteen to twenty barbs.

Sex Determination

The sex of each bird was determined at the time of examination. Sex was determined by the coloration of the feathers on the head. The cock (male) has conspicuous white markings on the side of the head and on the throat, whereas the hen (female) has a light buff brown marking on the side of the head and throat.

Crop Analysis

The plant and animal material was classified and identified to the lowest possible taxonomic level. The seed identification was made with the aid of Martin and Barkley's, Seed Identification Manual (1961). A two set series of fifteen and thirty-four plates of photographs of drawings of common "weed seeds" published by the Division of Photography, Office of Information, United States Department of Agriculture, Washington 25, D.C., was also of assistance. Crop seed samples were obtained from the Department of Agriculture, Austin Peay State University. There was no reference seed collection available; however, some use was made of the herbarium in the Department of Biology, Austin Peay State University. Identification of the smaller seeds was made with the aid of a biocular dissecting microscope; a 10x Stero Graf, model number A054, manufactured by the Graf Aspco Company, Chicago, Illinois. A three by five inch index card was taped to the stage of the microscope. On this card was drawn a circle which corresponded with the field of view. In this circle a smaller circle was drawn to mark the center of the field of view. This proved to be useful in locating a

particular seed under the dissecting scope.

The contents of a crop were emptied into a Kimax petri dish bottom. The contents were examined and the larger, more easily recognized constituents were removed and counted. The dish was then placed under the dissecting scope and the remaining items were identified and counted. The type and number of seeds and animals found were recorded in the ledger along with the other data for that particular bird. Any substance which could not be identified was classified as "unknown".

A few seeds were taken from each crop to build a reference collection. After the collection and crop analysis were complete, the percent volume and percent occurrence was calculated for each food type.

The method used for determining the volume was as described by Larimer (1960). The average volume per unit (one seed or insect) was found for each food type by determining the volume of a large number of units of the particular food type and dividing this total volume by the number of units. The volume was measured by the displacement of water. A specific volume of water was placed into a 10 ml. Fisher graduate cylinder and a given number of units of one food type was placed into the graduate cylinder containing the water. If the material did not sink, it was forced down by a screen which had a known volume of 0.10 ml. The difference between the water-line reading before the units were added and after the units were added was the volume displaced by the food. The total volume displaced by the food was divided by the number of units and this equalled the average volume per unit. The average volume per unit was multiplied by the number of units in each crop to derive the total volume occupied by a given food type in a given crop. The total volume of combined crops was determined by adding the total volume of each crop together. The percent of total volume was then derived by dividing the total volume occupied by each food type by the total volume of the combined crops. In the case where there were not enough seeds present to measure and derive an average per unit volume, an estimate was made by comparisons with seeds of known size. When only fragments of seeds occurred, the number of units present was determined by an ocular estimate as to the number of whole units present based on the size of the fragments. Most insect material was measured separately when there was enough material present to measure. Seldom was there enough leaf material present in a single crop to measure. The total volume occupied by leaf material was an estimate based on the size of other measured materials. The volume of the fleshy fruits was determined before the fruit had dried out.

The presence of one or more, whole or partial units in a crop represented an occurrence. Frequency of occurrence was calculated by dividing the total number of crops analyzed, into the number of occurrences of each food type.

The contents of the crops were classified into several categories. A major division was made

between plant and animal material, inorganic material and unidentified organic material. The plant and animal food types were divided into families and orders respectively, with the genus and species listed when possible. However, a large portion of the animal material was classified only to order because too much time would have been involved in trying to determine the genus and species of fragments of insects and other animals. The lowest taxonomic level of each food type was listed according to percent of total volume and percent occurrence. Data handled in this fashion illustrate the distribution of the food types as well as the major constituents of the crops by volume.

The weather data were obtained from Captain Arnold Lowder of the United States Air Force Weather Station at Fort Campbell, Kentucky. This weather station is adjacent to the study area. The data consisted of daily maximum, minimum and mean temperatures; amount of precipitation; velocity and direction of the wind; the occurrence of any thunderstorms; and the mean barometric reading based on hourly readings. These data were collected for each day of the 1968 bobwhite quail hunting season.

CHAPTER IV

RESULTS

A total of 204 quail crops were collected during the 1968 bobwhite quail hunting season at Fort Campbell, Kentucky. Of the 204 crops examined thirteen were empty. Ninety-five of the quail were examined during the first half of the season and the remaining 109 were examined during the second half. Quail were checked from thirty-five of the fifty-one areas.

Of the 204 quail examined, 57.6% were cocks (male) and 42.4% were hens (female).

Juveniles composed 82.0% of the 204 quail while only 18.0% were adults.

Food items classified as plant materials made up 97.95% of the total volume of the 204 crops examined. Animal material made up a total of 1.87% of the total volume and grit constituted 0.04%. A fourth category was made up of unidentified organic material and constituted 0.15% of the total volume.

Six plant families which occupied over 1.00% of the total volume; each combined, totaled 98.90% of the volume occupied by the plant material.

The legumes (Leguminosae) occupied the greatest percent by volume; 40.15%. Representatives of the legumes occurred 310 times. The Korean and Japanese lespedezas (Lespedeza stipulacea and L. striata) were grouped together as one food type because of the difficulty in distinguishing between the two when the husk was not present. It was the most common of the legumes, occurring in 149 of the crops. Wild bean (Strophostyles spp.), partridge pea (Chamaecrista spp.), and sericea (Lespedeza cuneata) were other important legumes.

The Cashew Family (Anacardiaceae) was represented 102 times. Rhus was the only genus represented in this family. Sumac (Rhus spp.) occupied 22.71% of the total volume.

The Honeysuckle Family (Caprifoliaceae) was represented by only one genus, Lonicera, which occurred in 75 crops and comprised 18.39% of the total volume.

The Composite Family (Compositae) made up 10.81% of the total volume and occurred a total of 149 times. The Composite Family was represented by a total of seven genera, of which the ragweeds (Ambrosia spp.), 91 occurrences; and bidens (Bidens spp.), 48 occurrences; were the most important. Less important genera were the sunflowers (Helianthus spp.), two thistles (Cirsium spp. and Silybum spp.), ironweed (Veronia spp.), and golden rod (Solidago spp.).

The Olive Family (Oleaceae) was represented by only one genus, the ashs (Fraxinus spp.), which accounted for 2.84% of the total volume and was represented in 19 crops.

The Laurel Family (Lauraceae) was the only other family which comprised over 1.00% of the total volume. Sassafras (Sassafras spp.), the only laurel represented, accounted for 1.41% of the total

volume, even though it only occurred in two crops.

The insects (Insecta) were the only animals to occupy over 1.00% of the total volume. The Order Hymenoptera comprised 31.42% of the total volume occupied by this class. (Table I)

Food Items

Korean and Japanese lespedezas ranked first in both percent volume and percent occurrence, occupying 36.42% by volume and occurring in 73.04% of the crops.

Sumac, probably over 95% smooth sumac (Rhus glabra), was second in total volume, occupying 22.71% of the total volume. It was represented in 50.00% of the crops examined.

Honeysuckle, ranked third in volume, constituted 18.39% of the total volume and was fifth in percent occurrence, occurring in 36.76% of the crops.

Common ragweed (Ambrosia artemisiaefolia) ranked fourth by volume, occupying 8.71% of the total volume and was also fourth in percent occurrence; 37.25%. (Figure 2)

Bicolor lespedeza (Lespedeza bicolor) ranked seventh in percent volume, 1.83%; and occurred in 3.43% of the crops.

Sassafras was ranked eighth in percent volume, occupying 1.41% of the total volume but only occurring in 0.98% of the crops.

Bidens (Bidens spp.) ranked sixth in percent volume, 1.91%; and occurred in 23.53% of the crops.

Ash (Fraxinus spp.) ranked fifth in percent volume, occupying 2.84% of the total volume and was represented in 9.31% of the crops.

Each of the other remaining food items, both animal and plant, occupied less than 1.00% of the total volume.

Ants occupied the greatest portion of the total volume of the animal material, 0.41%, and were represented in eleven crops.

Grasshoppers (Acrididae) were represented thirteen times and comprised 0.29% of the total volume.

Snails (Pulomonata) occurred in seven crops and occupied 0.28% of the total volume.

Some insects could be positively identified to species. The spotted cucumber beetle (Diabrotica duodecimpuncatata), (Disconycha caroliniana), and the leafhopper (Graphocephala coccinea) were all represented but made up only a small portion of the animal material. (Table II)

TABLE I

Classification of the Different Food Types

Classification	Times Represented	Percent of Total Food
Plant Material	709	97.95
LEGUME FAMILY (Leguminosae)	310	40.15
Bush Clovers (Lespedeza)	177	38.83
Korean and Japanese Lespedeza (L. stipulacea and L. striata)	149	36.42
Sericea (L. cuneata)	21	0.59
Bicolor Lespedeza (L. bicolor)	7	1.82
Desmodiums (Desmodium spp.)	12	0.02
Wild Beans (Strophostyles)	62	0.42
Small wild bean (S. leiosperma)	37	0.34
Wild Bean (S. helvola)	21	0.03
Wild Bean (S. umbellata)	4	0.05
Partridge Pea (Chamaecrista)	58	0.89
Milk Pea (Galactia regularis)	1	trace
GRASS FAMILY (Gramineae)	21	0.21
Smooth Crabgrass (Digitaria ischaemum)	4	0.02
Panic grass (Panicum spp.)	12	trace
Grama (Bouteoua spp.)	1	0.18
Johnson Grass (Sorghum halopense)	2	trace
Broom Sedge (Andropogon virginicus)	2	trace
COMPOSITE FAMILY (Compositae)	149	10.81
Ragweed (Ambrosia spp.)	91	8.73
Common Ragweed (A. artemisiaefolia)	76	8.66
Giant Ragweed (A. trifida)	15	0.07
Bidens (Bidens spp.)	48	1.91
Sunflower (Helianthus spp.)	4	0.15
Canada Thistle (Cirsium arvense)	1	trace
Milk Thistle (Silybum spp.)	1	0.02
Ironweed (Vernonia spp.)	1	trace
Goldenrod (Solidago spp.)	3	trace
LAUREL FAMILY (Lauraceae)	2	1.41
Sassafras (Sassafras spp.)	2	1.41
CASHEW FAMILY (Anacardiaceae)	102	22.71
Sumac (Rhus spp.)	102	22.71

TABLE I (CONTINUED)

Classification	Times Represented	Percent of Total Food
OLIVE FAMILY (Oleaceae)	19	2.84
Ash (*Fraxinus*)	19	2.84
BUCKWHEAT FAMILY (Polygonaceae)	2	trace
Smartweeds (*Polygonum* spp.)	2	trace
VINE FAMILY (Vitaceae)	3	0.72
Grapes (*Vitis* spp.)	3	0.72
ROSE FAMILY (Roseaceae)	8	0.23
Cherry (*Prunus* spp.)	3	0.11
Avens (*Geum canadense*)	4	0.01
Rose (*Rosa*)	1	0.12
HONEYSUCKLE FAMILY (Caprifoliaceae)	75	18.39
Honeysuckle (*Lonicera* spp.)	75	18.39
MINT FAMILY (Labiatae)	2	0.01
Germander (*Teucrium* spp.)	2	0.01
SEDGE FAMILY (Cyperaceae)	12	0.01
Sedge (*Carex* spp.)	4	0.01
Scleria (*Scleria ciliata*)	8	trace
ST. JOHNSWORT FAMILY (Hypericaceae)	1	trace
St. Johnswort (*Hypericum perforatum*)	1	trace
MAGNOLIA FAMILY (Magnoliaceae)	3	0.18
Magnolia (*Magnolia* spp.)	3	0.18
ANIMAL MATERIAL	80	1.88
SNAILS AND SLUGS (Gastropoda)	7	0.33
Snails (Pulmonata)	6	0.28
Slugs (Pulmonata)	1	0.05
INSECTS (Insecta)	69	1.52
Short-horned grasshoppers (Acrididae)	13	0.29
Insect larvae	3	0.03
Beetles (Coleoptera)	19	0.32
Ground Beetles (Carabidae)	3	0.15

TABLE I (CONTINUED)

Classification	Times Represented	Percent of Total Food
Leaf Beetles (Chrysomelidae)	4	0.03
Spotted Cucumber Beetle (*Diabrotica duodecimpuncata*)	3	0.02
Disconycha (*Disconycha caroliniana*)	1	0.01
Coleoptera	8	0.14
True Bugs (Hemiptera)	2	0.04
Wasps and Ants (Hymenoptera)	13	0.48
Ants (Formicidae)	11	0.41
Wasps (Vespidae)	2	0.07
Leafhoppers (Homoptera)	3	0.02
(Cicadellidae)	3	0.02
(*Graphocephalia coccinea*)	3	0.02
Insect pupae	1	0.27
Insect parts	19	0.08
SPIDERS (Arachnoidea)	3	0.02
Spiders (Araneae)	3	0.02
CENTIPEDES (Chilopoda)	1	trace
LEAF MATERIAL	51	0.27
GRIT	9	0.04
UNKNOWN	21	0.15

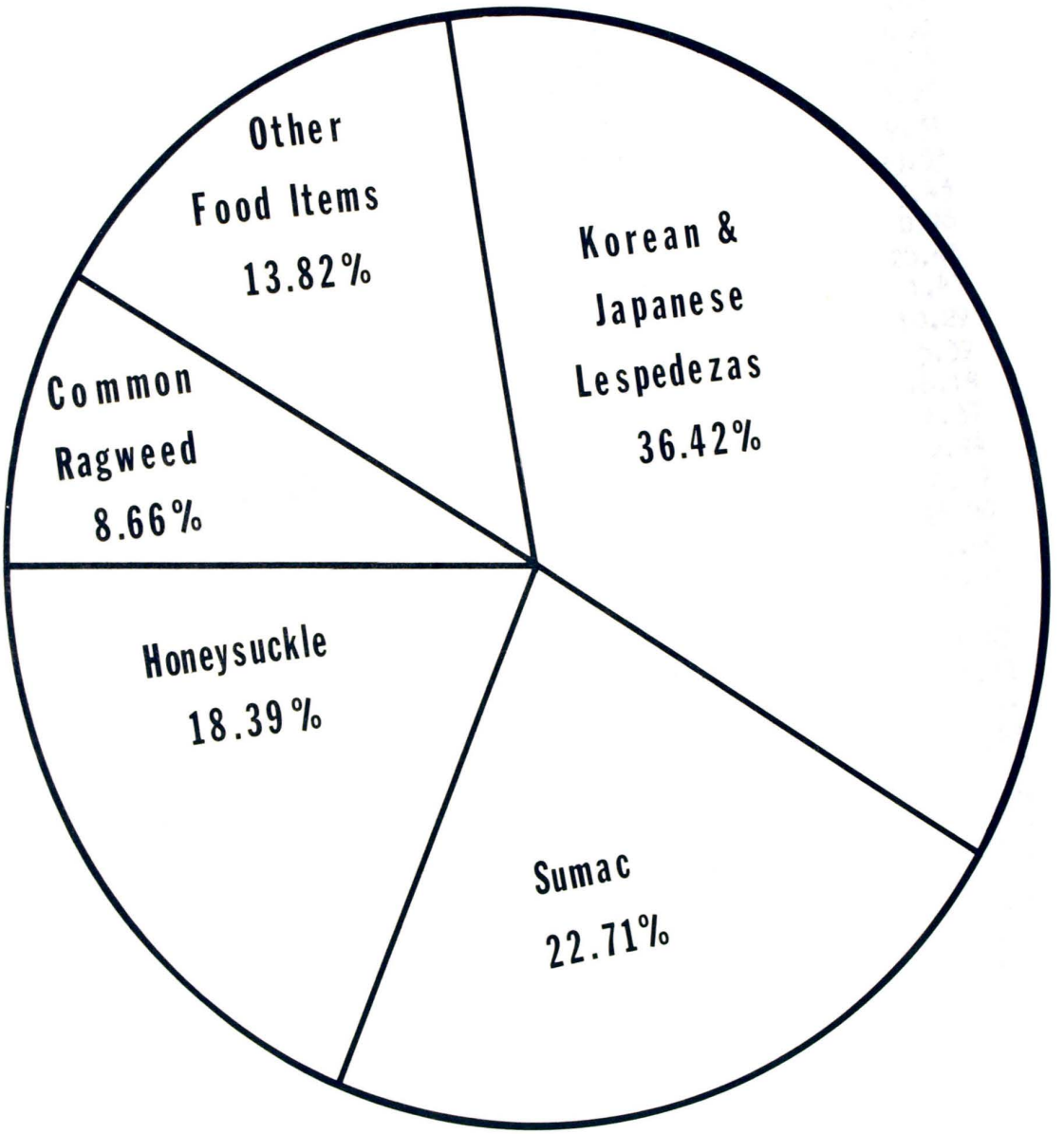


FIGURE 2

of the Total Volume Occupied by the Four Major Food Items

TABLE II

PERCENT VOLUME AND PERCENT OCCURRENCE OF EACH OF THE 57 FOOD TYPES RANKED IN DECENDING ORDER BY PERCENT OF TOTAL VOLUME

FOOD TYPES	PERCENT VOLUME	PERCENT OCCURRENCE
Lespedeza striata, L. stipulacea	36.42	73.04
Rhus spp.	22.71	50.00
Lonicera spp.	18.39	36.76
Ambrosia artemisiaefolia	8.66	37.25
Fraxinus spp.	2.84	9.31
Bidens spp.	1.91	23.53
Lespedeza bicolor	1.81	3.43
Sassafras spp.	1.41	0.98
Chamaecrista spp.	0.89	28.43
Vitis spp.	0.72	1.47
Lespedeza cunata	0.59	10.29
Formicidae (ants)	0.41	5.39
Strophostyles leiosperma	0.34	18.14
Acrididae (grasshoppers)	0.29	6.37
Pulmonata (snails)	0.28	2.94
Insect pupa	0.27	0.49
Leaf material	0.27	25.00
Bouteoua spp.	0.18	0.49
Magnolia spp.	0.18	1.47
Heilanthus spp.	0.15	1.96
Carabidae	0.15	1.47
Coleoptera	0.14	3.92
Rosa spp.	0.12	0.49
Prunus spp.	0.11	1.47
Ambrosia trifida	0.07	7.35
Vesperidae (wasps)	0.07	0.98
Pulmonata (slugs)	0.05	0.49
Strophostyles umbelata	0.04	1.95
Grit	0.04	4.41
Hemiptera	0.04	0.98
Strophostyles helvola	0.03	3.92
Insect larvae	0.03	1.47
Digitaria ischaemum	0.02	1.96
Diabrotica duodecimpunctata	0.02	1.47
Graphocephala coccinae	0.02	0.98
Araneae (spiders)	0.02	1.47
Silybum spp.	0.02	0.49
Desmonium spp.	0.01	5.88
Disconycha caroliniana	0.01	0.49
Carex spp.	0.01	1.96
Teucrium spp.		0.98

TABLE II (CONTINUED)

FOOD TYPES	PERCENT VOLUME	PERCENT OCCURRENCE
Geum canadense	0.01	1.91
Verona spp.	trace	0.49
Panicum spp.	trace	5.88
Polygonium spp.	trace	0.98
Scleria ciliata	trace	1.96
Sorghum halepense	trace	0.98
Andropogon virginianum	trace	0.98
Circium spp.	trace	0.49
Hypericum spp.	trace	0.49
Solidago spp.	trace	0.49
Galactia regularis	trace	0.49
Hair	trace	0.49
Paper	trace	1.47
Chilopoda (Centipedes)	trace	0.49
Insect parts	0.08	9.31
Unknown	0.15	10.78

On November 28, 1968, the first day the population was sampled, the mean temperature was 51.5°F. with a maximum of 61.0°F. and a minimum of 42.0°F. There were 1.26 inches of precipitation and the wind was out of the southwest at 15 knots with gusts up to 38 knots. The barometric pressure was 29.78 inches of mercury. Of the crops examined on this date, 38.14% of the total volume was Korean and Japanese lespedeza, 19.72% was common ragweed, 16.30% was honeysuckle, and 8.07% was sumac.

On November 29, 1968, the mean temperature was 38.0°F. There was only a trace of precipitation and the wind was out of the northwest at 4.0 knots. The barometric pressure was 30.30 inches of mercury. Of the crops examined on this date , 20.59% of the total volume was Korean and Japanese lespedeza, 28.84% was common ragweed, 12.38% was honeysuckle, and 5.93% was sumac.

On December 7, 1968, the mean temperature was 30.5°F. with a maximum of 40.0°F. and a minimum of 21.0°F. There was no precipitation. The wind was from the northeast at 10 knots with gusts up to 28 knots. The barometric pressure was 30.30 inches of mercury. The crops that were examined on this date contained 50.07% honeysuckle, 19.13% Korean and Japanese lespedeza, 9.45% sumac, and 1.63% common ragweed.

On December 15, 1968. the mean temperature was 20.5°F. with a maximum of 29.0°F. and a minimum of 12.0°F. There was no precipitation on this date; however, there had been light (trace) precipitation on the previous two days and 0.25 inches of rain on December 12, 1968. The wind was out of the northwest at 7 knots and the barometric pressure was 30.37 inches of mercury. The crops that were examined on this date contained 33.33% Korean and Japanese lespedeza, 18.31% honeysuckle, 27.96% sumac, and 1.32% was common ragweed.

On January 5, 1969, the mean temperature was 20.0°F. with a maximum of 33.0°F. and a minimum of 7.0°F. There was no precipitation on this date; however, on January 3, 1969, there was 0.15 inches of precipitation (approximately 1.50 inches of snow) which remained on the ground as a trace of snow through January 5, 1969. The wind was out of the south at 8 knots and the barometric pressure was 30.13 inches of mercury. On this date 45.63% of the total volume was made up of sumac, 23.24% was Korean and Japanese lespedeza, 20.19% was honeysuckle, and 0.03% was common ragweed.

On January 11, 1969, the mean temperature was 24.0°F. with a maximum of 34.0°F. and a minimum of 14.0°F. There was no precipitation and the wind was from the north at 1.00 knots. The barometric pressure was 30.32 inches of mercury. Of the crops examined on this date, 40.12% of the total volume was Korean and Japanese lespedeza, 29.54% was sumac, 24.92% was honeysuckle, and 0.57% was common ragweed.

On January 15, 1969, the mean temperature was 39.0°F. with a maximum of 40.0 F.°and a minimum of 35.0°F. There was no precipitation. The wind was from the northeast at 7 knots and the barometric pressure was 30.17 inches of mercury. On this date 55.42% of the total volume was Korean and Japanese lespedeza, 25.31% was sumac, 8.28% was common ragweed, and 4.19% was honeysuckle.

On January 26, 1969, the mean temperature was 23.5°F. with a maximum of 28.0°F. and a minimum of 19.0° F. There was 0.01 inch of precipitation which fell late in the afternoon; consequently, this snow had little effect on the foods utilized during the day. The wind was out of the east at 4 knots and the barometric pressure was 30.36 inches of mercury. Of the crops examined on this date 55.72% of the total volume consisted of Korean and Japanese Lespedeza, 14.54% was sumac, 8.48% was honeysuckle, and 7.08% was common ragweed. (Tables III and IV)

TABLE III

WEATHER CONDITIONS ON COLLECTION DAYS
AND DAYS PRECEDING COLLECTION DAYS

DATE	TEMPERATURE DEGREES FAHRENHEIT			PRECIPITATION IN INCHES	WIND DIRECTION AND VELOCITY IN KNOTS
	Max.	Min.	Mean		
Nov. 27	59	48	53.5	1.88	Se 06-G 18
Nov. 28*	61	42	38.0	trace	Nw 04
Nov. 29*	42	31	38.0	none	Ne 05-G 11
Dec. 6	42	20	31.0	none	E 03
Dec. 7*	40	21	30.5	none	Nw 10-G 28
Dec. 14	25	16	20.5	trace	Sw 10-G 18
Dec. 15*	29	12	20.5	none	Nw 07
Jan. 3	34	12	23.0	0.15	Nw 07-G 15
Jan. 4	19	6	12.5	none	Nw 04
Jan. 5*	33	7	20.0	none	S 08
Jan. 10	28	14	21.0	none	Nw 02
Jan. 11*	34	14	24.0	none	N 01
Jan. 14*	41	22	31.5	none	E 02
Jan. 15*	51	27	39.0	none	Se 03
Jan. 18	55	36	45.5	0.49	Vr 08-G 19
Jan. 19*	40	35	37.5	none	Ne 07
Jan. 25	31	18	24.5	none	Nw 02
Jan. 26	28	19	23.5	0.01	E 04

*Collection dates

TABLE IV

PERCENT OCCURRENCE AND PERCENT OF TOTAL VOLUME OF THE FOUR MAJOR FOOD TYPES FOR EACH COLLECTION DATE

DATE	KOREAN & JAPANESE LESPEDEZAS	SUMAC	HONEYSUCKLE	COMMON RAGWEED	TOTAL
Nov. 28, 1968					
Percent Occurrence	93.75	43.75	46.88	53.12	
Percent Volume	38.14	8.07	16.30	19.72	82.23
Nov. 29, 1968					
Percent Occurrence	81.48	29.63	25.93	51.58	
Percent Volume	20.59	5.93	12.38	28.84	67.74
Dec. 7, 1968					
Percent Occurrence	81.25	43.75	56.25	12.50	
Percent Volume	19.13	9.45	50.07	1.63	80.28
Dec. 15, 1968					
Percent Occurrence	77.78	44.44	33.33	55.56	
Percent Volume	33.33	27.97	18.32	1.32	80.94
Jan. 5, 1969					
Percent Occurrence	48.65	83.78	40.54	8.11	
Percent Volume	23.24	45.63	20.19	0.03	89.09
Jan. 11, 1969					
Percent Occurrence	57.14	42.86	33.33	38.10	
Percent Volume	40.12	29.54	24.92	0.57	95.15
Jan. 15, 1969					
Percent Occurrence	100.00	60.00	60.00	40.00	
Percent Volume	49.42	22.59	17.60	0.10	89.71
Jan. 19, 1969					
Percent Occurrence	83.33	66.67	22.22	38.89	
Percent Volume	55.42	25.31	4.19	8.28	93.20
Jan. 26, 1969					
Percent Occurrence	88.89	44.44	38.89	50.00	
Percent Volume	55.72	14.54	8.49+	7.08	85.83

CHAPTER V
DISCUSSION

Food Types

The contents of the 204 crops were divided into 57 categories. Of those 57 categories only a few of them were of major importance. Only eight food types comprised one or more percent of the total volume. Korean and Japanese lespedezas and sumac comprised 59.13% of the total volume and were ranked first and second respectively in frequency of occurrence, with the lespedezas occurring in 73.04% of the crops and sumac occurring in 50.00% of the crops.

Korean and Japanese lespedeza ranked first in both percent volume and percent occurrence, occupying 36.42% by volume and occurring in 72.04% of the crops. This is the chief food crop sown for quail at Fort Campbell, Kentucky. Over seven tons of Korean lespedeza are sown annually by the Post Forestry Division and the Rod and Gun Club. This is an established, important quail food. It ranked high in many of the food studies researched. In the present study, Korean and Japanese lespedezas were the only cultivated crop to show any importance as a quail food. All other food types were wild, "natural" foods.

Sumac, probably over 95% smooth sumac (Rhus glabra), was second in total volume, occupying 22.71% of the total crop contents. It was represented in 50.00% of the crops examined. In all other studies sumac was considered to be of little importance, occurring in only 5.20% of the crops in the study of Korschgen (1942) and occupying only 1.00% of the total volume. Davison (1949) states that sumac is eaten but is not important. However, Stoddard (1931) indicated that sumac is of more importance than other studies have indicated. A large portion of the other studies were conducted on land which was still under cultivation. Good farming practices greatly reduce the amount of sumac present; consequently, low availability. However; on the Fort Campbell Reservation, sumac is a frequent occurring woody species in the old fields; consequently, high availability.

Honeysuckle constituted 18.39% of the total volume and was fourth in percent occurrence, occurring in 36.76% of the crops. Like sumac, honeysuckle did not constitute a large portion of the contents of the crops in other studies. Davison (1949) states that honeysuckle is eaten but perhaps important only when snow or other conditions make other food supplies scarce. Here again availability is probably the answer for the high percentage. Good farming practices select against honeysuckle in farming regions but it flourishes on abandoned farmland at this latitude.

Common ragweed ranked fourth by volume, occupying 8.71% of the total volume, was third in percent occurrence, 37.25%. In other studies ragweed also ranked high. Stoddard (1931) indicated that ragweed is prevalent the year following a burn.

Seeds of green and white ash were found in only 9.31% of the crops but comprised 2.86% of the total volume. In the study conducted by Larimer (1960) ashes occupied only 0.03% of the total volume. Davison (1949) states that these seeds were eaten, but not important.

Bidens spp. ranked sixth in percent volume and seventh in percent occurrence. It occupied 1.91% of the total volume and occurred in 32.53% of the crops. Bidens spp. were of little importance in other food studies except for the study by Larimer (1960) where it ranked eleventh by percent volume. Bidens spp. are also prevalent in the year following a burn.

Bicolor lespedeza ranked seventh in percent volume, 1.82%, and occurred in 3.43% of the crops. Bicolor was found in only a few of the areas. It is an excellent food crop according to Davison (1949), but is difficult to establish in an area where there is a dense deer population such as is present at Fort Campbell.

Sassafras spp. were eighth in percent volume, occupying 1.41% of the total volume but only occurred in 0.98% of the crops examined. Sassafras spp. were important in other food studies.

The remaining food items were not considered to be of major importance since none occupied over 1.00% of the total volume. In some cases the occurrence of some seeds could be considered accidentals. These seeds are broomsedge (Andropogon virginianum), trace; golden rod (Solidago spp.), trace; and thistle (Cirsium spp.), trace.

Comparison with other Food Studies

These data show a definite difference between this study and other studies examined, except for the study conducted in Tennessee by Cady (1944) and Gray's (1940) study made of the Alabama quail. Cady's study, like the present research, was made of the quail on abandoned farmland. The other studies were made of the quail on areas which represented a cross section of land uses, including pasture, woodland, recreation land and farmed land.

There is a difference in latitude of the area in which the studies were conducted, which could account for some of the differences in food utilization. The most striking difference was the complete absence of cultivated grain crops in the crops examined. In the other studies, corn ranked first in Illinois and Indiana, second in Missouri and Pennsylvania, and third in Kentucky. Soybeans ranked second in Illinois, third in Virginia, fourth in Tennessee, fifth in Indiana and seventh in Missouri and Alabama. Wheat ranked third in Pennsylvania, fifth in Illinois, sixth in Indiana and Virginia and eighth in Tennessee. In the present study no corn, soybeans, or wheat were found.

Another striking difference was the high percent of sumac and honeysuckle found in the

present study. The explanation could very likely be availability. There is little grain grown on the reservation. That grain which is grown, mostly corn and milo, is harvested for winter feed for the horses of the riding stable. The grain which is left in the fields as a result of the inefficiency of the machinery is probably consumed by the mourning doves and quail in October and early November.

The reservation is abandoned farmland and consequently contains many grown up fields. The other studies were conducted in areas where the land was still being farmed, intensively so in Illinois and Indiana. This fact alone is partial explanation for the surprisingly high volume of honeysuckle and sumac found in the present study. In a farming region these plants are selected against by the farmers and ranchers. Therefore, these plants do not exist in great numbers in these areas. However, the field observations and previous work done by the author with deer exclosures on the military reservation tend to indicate that sumac and/or honeysuckle are predominent in the "old field" situation on the reservation.

Korean and Japanese lespedezas were highly ranked in almost all of the studies except for the study in Pennsylvania where there was no occurrence. They ranked first in Missouri, Kentucky, Tennessee, Alabama (Gray 1940), Alabama (Johnson and Pearson 1948); second in Virginia; third in Illinois, Indiana, and Oklahoma (Lee 1948). Korean lespedeza is sown in large quantities by the Post Forestry Division and the Rod and Gun Club at Fort Campbell, Kentucky. Areas which are sown include roadsides, edge of firebreaks, woods edge, and some open fields. The lespedeza which is sown along the roadsides seems to make up the largest portion of the land dominated by lespedeza. However, there are no data concerning the amount of seed sown in any given area (roadside, open field, etc.).

It is interesting to note that the roads on the reservation are, in most cases, graveled with limestone gravel. Since the reservation is a troop training area, the roads are intensively used. As a result the limestone dust which is stirred up by the vehicles traveling the roads settles on the sides of the roads and actually limes the land adjoining the roads. This is beneficial to plant growth according to Tisdale and Nelson (1966).

The presence of ragweed was in agreement with the other studies. It ranked fourth in the present study and in Indiana and Alabama (Johnson and Pearson 1948), but was rated first in Virginia; second in Kentucky, Tennessee and Oklahoma; third in Missouri; and sixth in Illinois.

Another food type which was conspicuous by its absence was acorns (Quercus spp.). There was not a trace of acorns found in any of the crops examined in the present study, but it was found to be important in the other studies. It ranked first in Alabama (Allen and Pearson 1945); second in Oklahoma (Baumgartner et al. 1952); third in Alabama (Johnson and Pearson 1948); fourth in Illinois; fifth in Missouri and Oklahoma (Lee 1948); and seventh in Virginia (Baldwin and Hanley

1946). According to the Tennessee Game and Fish Commission there was a mass crop failure in the 1968 season. Here again availability may be responsible for the absence of acorns. There is also a large white-tailed deer population on the reservation which along with the eastern gray squirrel (Sciurus carolinensis) could compete with the quail for acorns. No data were collected which was related to the availability of, or competition for, acorns. However, from field observations it was obvious that a large portion of the forested areas consisted of oaks (Quercus spp.).

Sericea lespedeza (Lespedeza cunata) occurred in 10.29% of the crops examined and occupied 0.59% of the total volume. There was no occurrence of sericea in the study by Larimer (1960). Davison (1949) states that sericea is a poor food but is useful as a cover crop on field borders.

Partridge pea (Chamaecrista fasciculata and C. nictitans) ranked ninth by volume in the present study, occupying 0.89% of the total volume and was represented in 28.43% of the crops. It ranked forty-third in the study by Larimer (1960). Davison (1949) states that it is a good food and is kept in production by fire. This fact could possibly explain the high ranking in the present study, since there is a two-year burning program on the reservation.

The small wild beans (Strophostyles spp.) ranked twelfth with the combining of the three species S. leiosperma, S. helvolva, and S. umbelata. This is again similar to previous studies where it ranked fourteenth in Illinois; ninth in Missouri and Oklahoma (Lee 1948), and sixth in Oklahoma (Baumgartner et al. 1952). (Table V)

Other seeds found in this study which are considered "non-important" by Davison (1949) were wild rose (Rosa spp.), 0.12% total volume; wild grape (Vitis spp.), 0.73% total volume; Johnson grass (Sorghum halepense), trace; crab grass (Digitaria spp.), 0.02% total volume; and giant ragweed (Ambrosia trifida), 0.07% total volume.

Grasshoppers ranked fourteenth in the present study and occupied 0.28% of the total volume. This coincides with other studies where it ranked thirteenth in Illinois, Alabama (Gray 1940), and Alabama (Johnson and Pearson 1948); twelfth in Alabama (Allen and Pearson 1948); and seventeenth in Virginia.

Ants ranked twelfth by volume in the present study but were not as significant in other studies. In the study by Larimer (1960) ants ranked twenty-third by volume.

Pieces of printed paper occurred in three of the crops examined. Hair (Odiocoilus virginianus) was found in one crop. Both of these occurrences were considered accidentals.

Sustaining Values of Different Food Types

Based on a study conducted by Newlon et al. (1964) the sustaining values of some foods

TABLE V

A COMPARISON OF THE PRESENT STUDY TO OTHER STUDIES WITH REGARD TO PERCENTAGE OF TOTAL VOLUME OF CROP CONTENT AND RANK OF FOOD ITEMS (LARIMER 1960)

Symbols: — = No occurrence; x = Less than 1.00 percent

Collection	Corn		Soybean		Korean & Japanese Lespedezas		Oak (Acorns)		Wheat		Common Ragweed		White Sassafras		Desmodium		Slugs		Jewelweed		Bidens		Cowpea		Short Horned Grasshoppers		Small Wild Bean	
	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank	% Volume	Rank
KENTUCKY present study	—		—		36.42	1	—		—		8.66	4	1.41	8	x	40	x	29	—		1.91	6	—		x	14	x	12
ILLINOIS Larimer 1960	27.79	1	22.43	2	8.66	3	7.19	4	5.45	5	4.58	6	3.80	7	2.94	8	2.81	9	1.82	10	1.38	11	1.36	12	1.32	13	1.00	14
MISSOURI Korschgen 1969	1.80	2	2.60	7	18.50	1	6.60	5	x		1.27	3	2.90	6	2.30	8	—		x		x		x		x		1.80	9
INDIANA Reeves 1948	27.40	1	4.00	5	15.70	3	1.40	9	4.00	6	9.10	4	21.20	2	1.20	11	—		3.90	7	x		—		x		x	
KENTUCKY Barbour 1951	8.90	3	—		29.52	1	—		—		6.57	2	—		5.36	4	—		—		—		—		—		—	
TENNESSEE Cady 1944 PER CENT WEIGHT	1.43	6	3.57	4	62.38	1	x		1.15	8	14.29	2	x		3.73	3	—		x		x		x		—		—	
VIRGINIA Baldwin & Handley 1946	3.40	10	7.60	3	9.70	2	3.70	7	4.00	6	21.30	1	x		3.60	8	—		1.80	13	x		5.10	5	1.00	17	—	
ALABAMA Gray 1940	x		—		27.96	1	2.49	9	—		1.76	12	—		9.99	2	—		—		—		2.99	6	1.70	13	—	
ALABAMA Johnson & Pearson 1948	2.29	12	4.38	7	20.56	1	1.1.65	3	—		8.88	4	—		5.44	5	—		—		—		11.86	2	1.93	13	—	
ALABAMA Allen & Pearson	3.21	8	2.11	11	1.54	14	23.71	1	—		—		—		3.76	7	—		—		—		8.88	4	1.72	12	—	
OKLAHOMA Lee 1948	3.83	8	—		8.74	3	6.35	5	1.05	22	10.86	2	—		x		—		—		x		x		—		2.43	9
OKLAHOMA Baumgartner et al. 1952	5.60	7	—		8.70	5	10.90	2	x		10.40	4	—		1.30	15	—		—		—		—		—		6.80	6
PENNSYLVANIA Bennett & English 1939	21.00	2	—		—		x		9.00	3	25.00	1	—		—		—		—		—		—		x		—	

utilized by the quail in the present study are as follows:

Korean and Japanese lespedezas which ranked first by volume and occurrence in the present study was classified as an intermediate food, based on their food value to the quail. The chemical analysis; Newlon et al. (1964), of the Korean lespedeza proved to be the highest in protein and lowest in carbohydrates of the foods tested.

Sumac, which ranked second in percent volume and second in percent occurrence was ranked very low as a sustaining food. A study conducted by Nestler and Bailey (1944) indicated that quail did not prefer sumac fruits in any form; therefore, quail which were fed only sumac lost weight rapidly. Nestler and Bailey (1944) indicated that a straight sumac diet could not maintain quail through a severe winter. Quail which were fed a diet of 50.0% sumac fruit pulp and a nutritious food maintained body weight for fourteen days. Quail fed a 75.0% sumac diet lost weight rapidly. Newlon et al. (1964) stated that smooth sumac (Rhus glabra) appeared capable of sustaining quail for only a few days at the most during severe winter weather. Chemically, sumac was lowest in protein and highest in fiber of the foods tested.

Sassafras spp. ranked eighth in percent volume but was found in only 0.98% of the crops. The author feels that the percent occurrence gives a truer representation of the utilization of sassafras in the present study because of the large size of the sassafras seeds as compared to the other seeds of the study. Newlon et al. (1964) ranked sassafras as among the highest of the foods examined in its ability to sustain quail in the winter months. However, as an emergency food, sassafras has the disadvantage of being relatively unavailable during periods of snow, according to Newlon et al. (1964). Chemically, according to Newlon et al. (1964), sassafras contained the most fat (44.4% of total weight) of the foods tested, and was second in percent protein with 17.12% of the total weight.

Sericea lespedeza ranked eleventh by percent volume and tenth in percent occurrence in the present study, but was ranked very low in its sustaining value by Newlon et al. (1964). In a study conducted by Williamson (1955) on the feeding habits of pen reared quail, all the quail fed only sericea died by the fifth week and had an average weight loss of 39%. In the pilot study done by Newlon et al. (1964) prior to the principal study, all the quail fed only sericea were dead by the third week, with an average weight loss of 44%. The chemical analysis indicated sericea to be high in percent fiber and protein and moderately low in fat content.

The only other food found in the present study which was also tested by Newlon et al. (1964) was rose (Rosa spp.). It ranked twenty-fourth in percent volume and was represented in only one crop. Newlon et al. (1964) ranked rose with sericea as for its sustaining value. Williamson (1957) found that quail fed a straight diet of rose hips lost 35% of their body weight in one week. The findings of Newlon et al. (1964) were similar, with a loss of 31% of body weight in one week. The

chemical analysis showed rose to be second to sumac in percent fiber with 25.58%, and lowest in moisture with 1.86%.

Other foods analyzed by Newlon et al. (1964) which were not represented in the present study were pearl millet, red ripper pea, foxtail millet, corn and milo, all of which are cultivated crops.

Seasonal Food Relations

Obviously there are changes in the dietary trends of the quail from season to season. The present study was only conducted from November 28, 1968 through January 26, 1969. The data indicate there was a change in the food habits during this period of time. There was an increase in the utilization of Korean and Japanese lespedeza from November through January, going from 38.14% of total volume on November 28, 1968, to a high of 55.72% of total volume on January 26, 1969. This is in accord with Korschgen (1952) who concluded from his study that the use of Korean lespedeza by quail was negligible in September but increased steadily through the fall and winter months.

Another evident change in utilization was the amount of common ragweed eaten by the quail. On November 28, 1968, 19.72% of the total volume of the crops was made up of ragweed. The percent then dropped to 1.63% on December 7, 1968, and remained below this figure until January 19, 1969, at which time ragweed occupied 8.28% of the total volume. This figure was similar to that of 7.08% which was obtained on January 26, 1969. These data correspond with Stoddard (1931) who states that the seeds of common ragweed are a favorite with the quail during October, November and December. Korschgen (1952) states that the greatest utilization of ragweed by quail was during October, November and December following maturity of the seeds and again during February, presumably after the winter snows.

Both sumac and honeysuckle indicate some seasonal change but these changes in utilization follow more closely the daily weather conditions than they do a general seasonal change.

The top four ranked foods combined, totaled more than 80.00% of the total volume on each collection date except November 29, 1968. On this date there was an unusually high percent of sassafras, ash and grape in the diet. (Figure 3)

Food Utilization as Related to Weather Conditions

Weather conditions affected the foods that are available to the quail for consumption by restricting the quail to a given type of habitat and by actually covering the seeds to an extent that the birds cannot locate them. Snow and ice can cover the seeds and heavy rains can cause them to lodge in the mud.

The data indicate that the presence of snow has the greatest effect on the foods utilized by the

FIGURE 3

Seasonal Variations in Food Utilization

quail. When there was a trace of snow covering the ground, as was the case on January 5, 1969, the percent composition of sumac and honeysuckle showed a definite increase. On November 29, 1968, honeysuckle made up 18.32% of the total volume. On January 5, 1969, honeysuckle composed 20.19% of the total volume.

The utilization of sumac was also most intensive during periods of snow and low temperature. The percent composition of sumac rose from 9.45% on December 7, 1968, to 45.63% on January 5, 1969 (snow), and then dropped to 29.45% on January 11, 1969.

The utilization of Korean and Japanese lespedeza was inversely related to that of honeysuckle and sumac. Korean and Japanese lespedeza were at their lowest percent on December 7, 1968, and January 5, 1969; 19.13% and 23.34% total volumes, respectively.

No definite relationship existed between weather conditions and the utilization of common ragweed; however, the lowest percent volume of ragweed occurred on January 5, 1969; 0.03%.

No definite correlation could be drawn between food utilization and any other single weather condition. The data did indicate that on days following a sudden drop in temperature to below freezing and there was a strong, gusty wind, the utilization of honeysuckle and sumac increased. On December 7, 1968, the mean temperature was 30.5°F. This was the second and most severe freeze this far in the winter. The wind was from the northwest at 10 knots with gusts up to 28 knots. Of the crops examined on this date, 50.07% of the total volume consisted of honeysuckle. This was an increase of 37.68 percentage points over the preceding collecting date and 31.75 percentage points higher than the percent volume for the following collecting date.

These data indicate that honeysuckle and sumac are emergency foods used more extensively during periods of inclement weather. Honeysuckle offers both cover and food during periods of snow, low temperatures and high wind. The honeysuckle vines hold the snow up off the ground, forming air pockets in which the quail can remain. While in these pockets the honeysuckle fruits are available to the quail. These vines also offer good protection from high winds. Davison (1949) states that even in sparse cover, during priods of high wind, there is relatively little wind near the ground. This indicates that wind is not an influencing factor. However, the author believes that during periods of low temperature, wind would remove the insulating envelope of air from around the quail, causing a more rapid loss of body heat. This insulation would not be as readily lost if the quail were in dense honeysuckle cover. The leaves above the quail would keep the surface winds from circulating the air in the vines. As a result there would be less loss of body heat.

The increase in the utilization of sumac and honeysuckle during inclement weather corresponds with the utilization of soybeans by quail in the study by Larimer (1960). Larimer's study also indicated a decrease in the amount of Korean and Japanese lespedeza utilized during periods of snow,

probably as a result of being covered by the snow and being unavailable. (Figure 4)

Sex Ratio

The results of sexing 204 bobwhite quail indicated 57.60% were cocks (males) and 42.40% were hens (females). These data correspond with the findings of Stoddard (1931). The fewest percent of cocks found in his studies was 51.6% and the highest percent was 57.0%. The reason Stoddard (1931) gave for the higher percent of cocks was there is a higher mortality rate among mature hens. He noted that the cocks were more dextrous in flight than the hens. This would make the hen an easier target for hawks and owls. Also, the accomplished quail hunter usually shoots one of the first quail to rise, which would probably be the alert cocks. This would account in part for a greater number of cocks in the game bag than hens. Some hunters state that they can distinguish between cocks and hens on the rise and shoot only the cocks. The author has done this only on a few occasions when the quail flushed closely and slowly. Stoddard (1931) also states that the hens do the greater portion of the incubation and are probably captured on the nests more often than the cocks.

An excess of cocks in a population is not considered detrimental unless the number is exceptionally unbalanced. According to Davison (1949) bachelor cocks have been known to adopt orphaned covies. This factor would seem to lessen the seriousness of the low proportion of hens.

Age Distribution

Odum (1954) states that in the game animals, the ratio of juveniles to adults (first year animals to older animals) determined during the season of harvest may aid in estimating natality and survival of young from the previous breeding season. This would provide an index to the population trends. In the present study 82.00% of the quail examined were juveniles and 18.00% were adults. This ratio, according to Odum (1954), indicates that the population was in good condition. However, more than one year's results is necessary to determine whether or not a population is increasing in productivity.

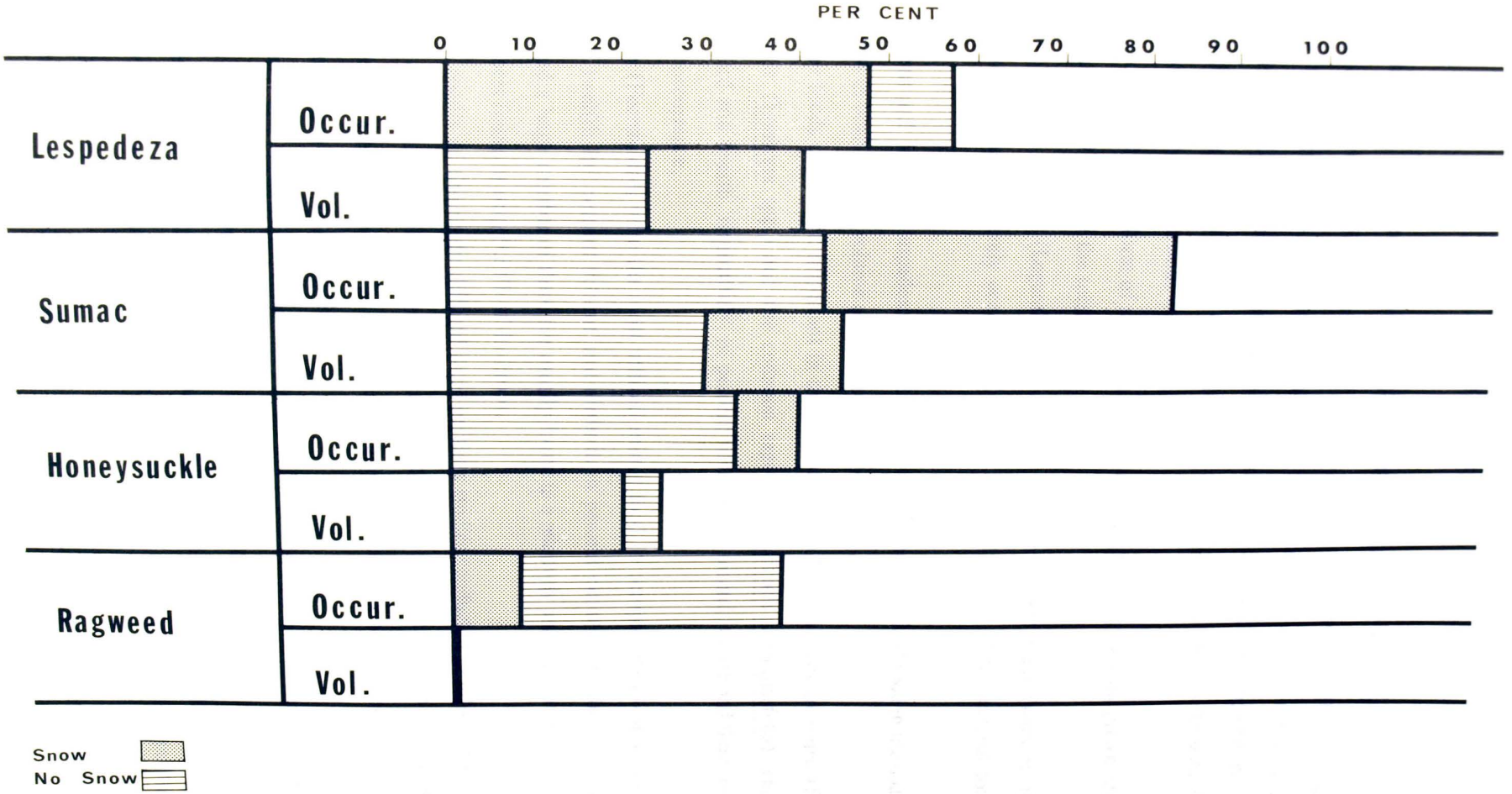


FIGURE 4

Food Utilization During Periods of Snow and No Snow

SUMMARY

A study was conducted of the bobwhite quail population of the Fort Campbell Military Reservation during the 1968 bobwhite quail hunting season; November 27, 1968 through January 31, 1969. In this study 204 quail were examined for sex and age, and a crop analysis was performed on each bird. The data from the crop analysis were also correlated with existing weather conditions.

The following are conclusions concerning this quail population, based on the data obtained in the present study and comparisons with other studies:

Plant material in the form of seeds was the most utilized food type in the present study. Plant material occupied 97.95% of the total volume.

The Legume Family (Leguminosae) was the most important plant family in this study. Members of the Legume Family occupied 40.15% of the total volume of the material consumed by the quail.

Korean and Japanese lespedeza (Leguminosae) was the most utilized food in the quails' diet. It ranked first in both percent volume and percent occurrence.

Other foods considered important in the diet of the quail in this study are sumac (Rhus spp.), honeysuckle (Lonicera spp.) and the common ragweed (Ambrosia artemisiaefolia). These ranked second, third and fourth, respectively, in percent volume and second, fourth and third, respectively, in percent occurrence.

Ants (Formicidae) were the most utilized animal food. It occupied 0.41% of the total volume. It ranked twelfth by percent volume and eleventh in percent occurrence. The fact that ants are colonial and a large number of them are usually found in a relatively small area could account for the large numbers found in only 9.31% of the crops.

The results of this study differed from previous studies conducted in different regions of the bobwhite quails' range, in that there were no cultivated grain crops represented in the present study. Also, there was a higher percentage of sumac and honeysuckle in the present study. The author feels these differences are due to availability.

Korean and Japanese lespedeza and sumac, which ranked first and second in utilization, have relatively low sustaining values. Considering the high utilization of foods of low sustaining values, the reservation could possibly increase the amount of available energy(food carrying capacity) during the winter months if more nutritious foods such as foxtail millet, corn and/or milo were introduced to the food plots or strips.

According to Odum (1954) the ratio of 82% juveniles to 18% adults indicates a productive

population. However, these data need to be collected annually in order to establish productivity trends.

The sex ratio of 57.6% cocks to 42.4% hens was in accord with Stoddard (1931) and considered to be normal.

Snow was considered to be the most influential weather factor affecting food utilization. During such periods of inclement weather honeysuckle and sumac were important "emergency" foods.

Allen, R. H., Jr., and A. M. Pearson. 1945a. 01' bobwhite's November menu. Ala. Cons. 17(5): 8-10.

_____.1945b. December diet of whislin' bob. Ala. Cons. 17(6): 8-14.

Baldwin, W.P., and C. O. Handley. 1946. Winter food of bobwhite quail in Virginia. J. Wildl. Mgmt. 10(2): 142-149.

Barbour, R. G. 1951. Observations on the fall and winter food of bobwhite quail in Kentucky. J. Wildl. Mgmt. 15(1): 108.

Baumgartner, F.M., M. J. Morris, J. L. Steele, and J. E. Williams. 1952. Oklahoma bobwhite food relations. N. Am. Wi ldl. Conf. Trans. 17: 338-358.

Bennett, L. J., and P. F. English. 1939. The fall foods of ringneck pheasants and bobwhites. Pa. Game News. 10(1); 8,9.29.

Braun, E. L. 1950. Deciduous forests of eastern North America. The Blakiston Co. Philadelphia, Pa. viv+596 pp.

Cady, E. R. 1944. Winter quail foods on abandoned farm lands in the Norris Reservoir area. Tenn. Acad. Sci. Jour. 19(1): 10-15.

Davison, V. E. 1949. Bobwhites on the rise. Scribner's Sons, New York. 150 pp.

Gray, A. M. 1940. Winter foods of the bobwhite quail in the Black Belt Soil Province of Alabama. Ala. Dept. of Cons. 23 pp.

Haugen, A. O. 1957. Distinguishing juvenile from adult bobwhite quail. J. Wildl. Mgmt. 21(1): 29-32.

Johnson, B. C., and A. M. Pearson. 1948. Bobwhite's December diet. Ala. Cons. 20(6): 4-13.

Korschgen, L. J. 1948. Late-fall and early-winter food habits of bobwhite quail in Missouri. J. Wildl. Mgmt. 12(1): 46-47.

_____. 1952. Analysis of the food habits of the bobwhite quail in Missouri. Mo. Cons. Comm., Div. of Fish and Game. 59 pp.

Larimer, E. J. 1960. Winter foods of the bobwhite in southern Illinois. Ill. Nat. Hist. Survey Biol. Notes 42. 35 pp.

Lee, L. 1948. The fall and winter food of the bobwhite in Oklahoma. Oklahoma Game and Fish Dept. 23 pp.

Martin, A. C., and W. D. Barkley. 1961. Seed identification manual. Univ. of Calif. Press, Berkley. 221 pp.

Newlon, C. F., T. S. Baskett, R. P. Brietenbach, and J. A. Stanford. 1964. Sustaining values of emergency foods for bobwhites. J. Wildl. Mgmt. 28(3): 532-542.

Nesler, R. B., and W. W. Bailey. 1944. Sumac fruit as a food for bobwhite quail. Am. Midland Naturalist. 31(3): 689-696.

Odum, E. P. 1959. Fundamentals of ecology. W. B. Saunders Co. xvii + 596 pp.

Reeves, M. C. 1954. Bobwhite quail investigation. Final Report. Ind. Dept.of Cons., Div. of Fish and Game. 151 pp.

Richardson, L. R. 1969. A call count census of the bobwhite quail and mourning dove of Montgomery County, Tenn. Research paper, Austin Peay State Univ. 19 pp.

Scott, D. F. 1958. Fire and quail management at Fort Campbell, Kentucky. Office of the Post Engineer, Fort Campbell, Ky. 10 pp.

Stoddard, H. L. 1931. The bobwhite quail. Scribner's Sons, New York, 559 pp.

Taber, R. D. 1963. Criteria of sex and age, p. 320-329. In H. S. Mosby, Wildlife investigational techniques. The Wildlife Society.

Tisdale, S. L., and W. L. Nelson. 1966. Soil fertility and fertilizers. The Macmillan Co., New York. 694 pp.

Williamson, H. G. 1955. Feeding experiments on pen reared quail. Okla. Game and Fish Dept. P.-R., Project W-44-R-4. 8pp.

_____.1957. Feeding experiments on pen reared quail. Okla. Game and Fish Dept. P.-R., Project W-24-D-12. 5 pp.