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The Food Habits of the Ring-necked Pheasant in Central Nebraska

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COLLEGE OF AGRICULTURE UNIVERSITY OF NEBRASKA
AGRICULTURAL EXPERIMENT STATION
RESEARCH BULLETIN 50

The Food Habits of the Ring-necked Pheasant in Central Nebraska

M. H. SWENK

Department of Entomology

Lincoln, Nebraska
November, 1930

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CONTENTS

	Page
Summary	3
Pheasant Introductions into America.....	6
Pheasant Introductions into Nebraska and Other Missouri Valley States.....	7
Open Seasons on Pheasants in Nebraska.....	8
General Life History and Habits of the Pheasant in Nebraska.....	9
Region in Nebraska from Which Complaints of Damage by Pheasants Have Come.....	11
Plan of the Present Investigation of the Food of the Pheasant.....	12
The Food Habits of the Pheasant in Other States.....	13
Food habits in the Pacific Northwest.....	15
Food habits in Massachusetts.....	15
Food habits in Colorado.....	16
Food habits in Utah.....	18
Food habits in South Dakota.....	20
Food habits in the United States in general.....	20
Summary of the Year's Food Based on the Crop Contents of 100 Nebraska Pheasants.....	21
Percentages of Various Foods in the 100 Pheasant Crops.....	23
Vegetable matter.....	23
Animal matter.....	28
General Considerations.....	31
Literature Cited.....	33

SUMMARY

Pheasants, including the Chinese and the so-called English pheasants, with their hybrid the ring-necked pheasant, have been introduced and established in a large area in the northern United States during the past 50 years. During the past 15 years continued importations of these birds into Nebraska, together with the rapid increase of those already established, have built up a large pheasant population in the state, estimated at more than a million birds. They have especially thrived in a block of 16 counties in east-central Nebraska. Protection was afforded them until 1927, when short open seasons were permitted in the fall in certain counties that were well stocked. In these counties with a relatively high pheasant population the economic status of the pheasant has become a controversial matter, the bird having both friends and enemies among the farmers. Because of the contradictory claims concerning its food habits, in 1929 a study of the year's food of the bird was made in the heart of the region from which the bulk of the complaints of injury to crops have emanated. This study was based on the crop and gizzard contents of 50 male and 50 female pheasants, taken in varied habitats, 8 each month, except in May and June when 10 were taken.

The food was found to consist of vegetable matter, such as grains, seeds, pods, berries, and plant debris, to the extent of slightly over 89 per cent, and of animal matter, such as insects, spiders, millipedes, earthworms, snails, and small vertebrate animals, to the extent of nearly 11 per cent of the food of the year. The charge that the pheasant is essentially a granivorous bird is well sustained in this study, for over 78 per cent of the crops containing any food contained grain, chiefly corn, but also oats, barley, wheat, cane, and rye in the order mentioned, to the average amount per bird of 35 kernels of corn (and popcorn), 25 of oats, 7 of barley, 5 of wheat, and 1 of cane. Cultivated grains formed about 76 per cent of the food of the year; corn, oats, barley, and wheat formed, respectively, about 67, 5, 3, and 1 per cent of the year's food. Corn was most heavily eaten during the winter months, forming over 90 per cent of the food for December, January, and February, and was least eaten during June, July, and August, when it formed about 22 per cent of the food for those months. Some injury is done to sprouting corn in May by the pheasants' pulling it up. Oats were eaten chiefly in July and August, when they formed nearly 35 per cent of the food of those months, the amount eaten during other months, except June, being trifling. Barley also was chiefly eaten during July and August, forming nearly 14 per cent of the food of these months. Wheat was eaten chiefly in March, at spring wheat sowing time, and in July, at wheat harvest time, forming about 7 per cent of the food of these two months. Cane and rye were but slightly eaten at any time.

Weed seeds formed about 4 and grass seeds about 2 per cent of the food of the year. The seeds of smartweed, black bindweed, lady's thumb, and other *Polygonums* alone formed about 2 per cent of the food of the year, and nearly 25 per cent of the food of March. Giant ragweed seeds were freely eaten in the early spring, forming over 5 per cent of the food of March. Sunflower seeds were the favorites, next to the *Polygonums*, being eaten from October to May, inclusive, and forming nearly 14 per cent of the food of November. In December the seeds of the partridge pea made up between 4 and 5 per cent

of the food of that month. Several other weed seeds were found in small amounts. The grass seeds were all those of *Panicaceae*, nearly all green and yellow foxtail grass, but with a few seeds of barnyard grass, sandbur grass, and witch grass also.

Fruits, including those of the wild prairie rose, riverside grape, poison ivy, elder, wild raspberry, wolfberry, sandcherry, and chokecherry, important in the order given, formed a part of the food of the pheasant. Sandcherries were eaten from May to August, wild raspberries in July, chokecherries from July to November, elderberries in August, wild prairie rose apples from September to May, riverside grapes from October to June, wolfberries from November to March, and poison ivy berries from November to April. Vegetable debris, found in the crops every month of the year but chiefly from March to July and in November, reaching its height in May and June, was undoubtedly partly fruit pulp but more largely the foliage of various plants, including corn, alfalfa, sudan grass, etc.

Animal matter was mostly insects, which formed over 6 per cent of the food of the year. Beetles were the insects most freely eaten, they alone forming nearly one-half of the total insect food. Of chief importance from the economic standpoint among the beetles were the seed-corn beetle, which was taken from March to June; the May beetles, imbricated snout-beetle, and bill-bugs, which were eaten freely in May and June; the click-beetles, taken in May, June, and July; the sweet-potato beetles, eaten in June; the plains false wire-worm, taken in August; and the western corn root-worm beetles, consumed in August and October. The belief that pheasants are habitually heavy consumers of grasshoppers and crickets was not borne out in this study. These insects constituted but about 1.5 per cent of the year's food, and were eaten mainly in August and November, when they amounted to about 14 and 11 per cent, respectively, of the food of those months. Cutworms of several species were eaten freely in May and June, amounting to 7.6 per cent of the food for June, and including some of the most injurious corn-field cutworms in the state. Corn-ear worms and moths were eaten in October to nearly 3 per cent of that month's food. In March and April, and again in November, March-fly maggots were eaten freely, constituting 4.6 per cent of the April food. A few ants of several species, including the nurse ant for the corn-root aphid, were eaten from March to July.

Aside from insects, the animal matter included many earthworms, these forming 2.7 per cent of the year's food and 13.5 per cent of the food eaten during May. A few toads were eaten in June and July and some snails from April to June. Egg shells were found in 4 female birds taken in late May and early June, but it is believed that these were from eggs that were broken in the pheasants' own nests.

In general, the capacity of the pheasant for good or harm is great. Its economic status is essentially a local matter, dependent on local conditions. The predominantly a granivorous bird, a large portion of the grain eaten is probably waste grain. If not permitted to build up too large a population in any locality or on any farm the good done in destroying noxious insects probably will, on the whole, about balance the damage done to crops.

The Food Habits of the Ring-necked Pheasant in Central Nebraska

M. H. SWENK¹

The common or Caucasian pheasant (*Phasianus colchicus* subsp.) in its various races is probably the most cosmopolitan of all wild gallinaceous birds, for not only does it enjoy a wide native range in southeastern Europe and Asia, extending from the Sea of Azov and the Black Sea east to the Japan Sea and the Yellow Sea and from the Tropic of Cancer to the forty-eighth parallel in Manchuria (6), but also, because of its high value as a game bird, it has been introduced into many other parts of the world. Hardy, aggressive, and wary in nature, these birds have shown great adaptability, and usually succeed in permanently establishing themselves when they are introduced into a new region. Pheasants were known and esteemed by the ancient Greeks and Romans, who probably introduced them into their homelands. The latter people probably are responsible for the early importation of the pure, typical race of the species into France, Belgium, Great Britain, and Germany. Later (about 1173) these birds were successfully introduced into Sweden. They have also become established in the Hawaiian Islands, New Zealand, and elsewhere (8).

Of the 23 subspecies of the common pheasant recognized by Beebe (6), only the Chinese pheasant (*Phasianus colchicus torquatus* Gmelin), which in pure strain occurs in Manchuria, Korea, and eastern China, and the dark-necked, so-called English pheasant (*Phasianus colchicus colchicus* L.), have been introduced into this country in any numbers (7, 8, 9, 12). The latter probably was introduced in pure strain into England by the Romans and later spread over the whole of Great Britain, almost completely hybridizing in the eighteenth century and afterward in England with the subsequently introduced Chinese pheasant to produce the form now commonly known as the ring-necked pheasant.

¹The writer of this bulletin wishes to acknowledge his indebtedness to Mr. Frank B. O'Connell, Secretary of the Game, Forestation, and Parks Commission of Nebraska, and formerly Chief of the State Bureau of Game and Fish, for his encouragement and co-operation in making this study and for permission to possess pheasants for scientific study during 1929; to Mr. Jess A. Kovanda, Smith-Hughes Instructor in Agriculture of the Ord City Schools, for collecting and sending in the 100 birds as planned; to the Department of Animal Pathology and Hygiene of the University for the use of their facilities for removing the crops and gizzards and incinerating the carcasses of the birds; and especially to Mr. O. S. Bare, during 1929 a graduate student in the Department of Entomology and later Extension Entomologist, for his invaluable assistance in weighing and identifying the food items found in the digestive tracts of these pheasants.

PHEASANT INTRODUCTIONS INTO AMERICA

The Chinese pheasant was first successfully introduced in pure strain into eastern Oregon by O. N. Denny in 1880 and 1881 (1, 8, 9). The English pheasant in nearly pure strain was successfully introduced a few years later (1887) into New Jersey (8, 9). In later years to some extent these pure strains, from China and England, but far more commonly their hybrid, the ring-necked pheasant, from England, were imported into many states, becoming successfully established in a large number of them, including Nebraska (9, 11). The species has seemed especially to prosper in the upper Mississippi and Missouri River Valley regions (9, 11). The accompanying map shows the American range of these birds in 1929, according to McAtee (11).

The names Chinese, English, and ring-necked pheasant, as well as the adjectives "Oriental", "China", "Mongolian", "Oregon", "Denny", etc., have largely been used in such a loose and meaningless way in sports literature that the term ring-necked pheasant is coming to be used for any and all of

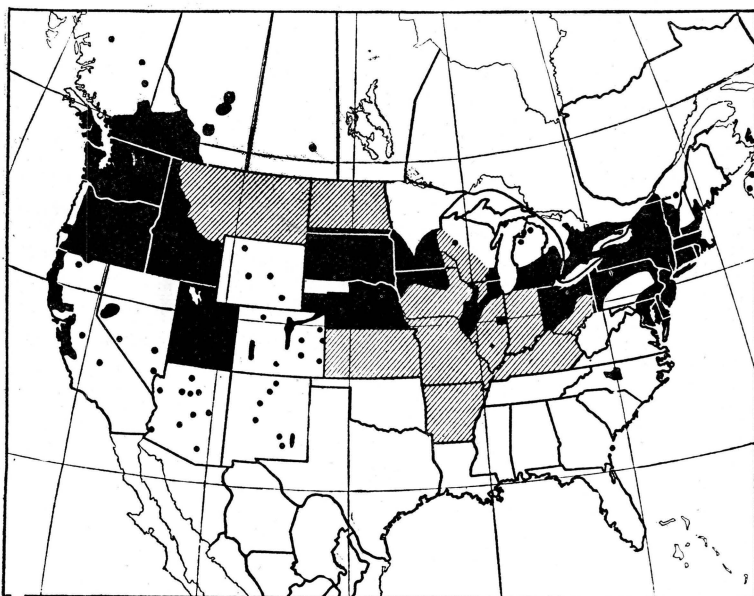


FIG. 1.—Range of the ring-necked pheasant in America in 1929. Solid black indicates localities where established; crosshatching indicates areas where systematic distribution has been carried on, the exact results not reported. (From McAtee, Circular 96, U. S. D. A., 1929.)

these birds found in the United States, and is so employed in this bulletin (9).

PHEASANT INTRODUCTIONS INTO NEBRASKA AND OTHER MISSOURI VALLEY STATES

The first importations of pheasants into the Missouri River Valley region were private efforts. State introductions followed. The first extensive private importations into Colorado took place in 1889 and 1894 (4), and the State took up the effort in 1901 (9). Following their introduction into northern Colorado in about 1908, by 1921 pheasants were abundant in eastern Colorado from the vicinity of Denver north to the Wyoming line, east of the mountains (4). In Kansas more than 3,000 pheasants were liberated from 1906 to 1909 (1). The first occurrences of pheasants in Nebraska were in 1900 to 1904, when individual birds were reported to have been shot at various points along the Kansas line in southeastern Nebraska—Table Rock, Pawnee, Barneston, etc.—these probably having been northward stragglers from some of the early private Kansas importations. Importations into South Dakota began privately about 1910, were soon taken up by the State, and the birds increased with such tremendous rapidity that by 1926 about a million pheasants were shot during the open season. This increased to about twice that number during the open season in 1927 (11).

According to information kindly supplied by Mr. Frank B. O'Connell, the State of Nebraska began stocking with pheasants about 1915, at which time several dozen birds were brought in. During the next ten years small shipments were purchased by the State each fall. These were supplemented in central Nebraska by private purchases of pheasants from game farms by individuals, who bred more pheasants from them. No very large number of pheasants were ever brought into Nebraska, probably not over 500 pairs altogether. Our present pheasant population has been bred within the State from this relatively small number of originally imported birds. In the spring of 1926 and of 1927 there were considerable trapping and transferring of pheasants from the more densely populated districts, in Sherman and Howard counties, to counties in eastern and southern Nebraska where pheasants were few or absent. In 1926, about 10,000 adult birds were thus captured and transferred, while about 30,000 adult birds were transferred in 1927. Practically every southern and eastern county in Nebraska received pheasants in these transfers. It is estimated that the pheasant population of the whole of Nebraska now (1930) totals over a million birds.



FIG. 2.—The ring-necked pheasant, male. (From McAtee, Farmers' Bulletin 497, U. S. D. A., 1912.)

OPEN SEASONS ON PHEASANTS IN NEBRASKA

Pheasants were accorded complete year-round protection in Nebraska until 1927. On account of the increased pheasant population in east-central Nebraska, in the spring of that year the Nebraska Legislature authorized the Department of

Agriculture to rule an open season on male pheasants in any county where such action was applied for by its county board. In 1929 this authority to open the season on pheasants was transferred by legislative act to the Game, Forestation, and Parks Commission, and the open season was restricted to a period of 15 days or less between September 11 and December 31. The Commission was also authorized to grant permission to individual farmers to destroy the pheasants on land owned or occupied by them when the birds were found to be destroying or damaging the crops. In 1927 the open season was only three days; in 1928 and 1929 it was ten days. In 1928 the counties with an open season were Garfield, Valley, Sherman, Buffalo, Hall, Howard, Merrick, Greeley, and Wheeler. In 1929 pheasant-shooting was permitted in Garfield, Valley, Sherman, Buffalo, Boone, Nance, Garden, and Morrill counties. The dates in 1927 were October 6 to 8, inclusive, and in both 1928 and 1929 were October 22 to 31, inclusive. About 25,000 birds were killed in 1928 and about 50,000 in 1929.

GENERAL LIFE HISTORY AND HABITS OF THE PHEASANT IN NEBRASKA

During the winter pheasants go about in flocks, these sometimes containing from 20 to 50 birds, the two sexes tending in the early winter to segregate into separate groups. As spring comes on (in March) the males begin to give their bantam-like crow, and later to flap their wings, and the larger flocks of males begin to break up into small ones. Cock fights become common. In April the males are seen traveling singly or with one hen, or sometimes with several hens. The males are more or less polygamous. Nesting begins in April, and complete sets of eggs are common before the end of that month. Nests are common thru May also. A setting contains from 7 to 17 eggs, usually 12 to 15, unless two hens lay in the same nest, when there may be more. The nests are placed on the ground in moist, sheltered situations in weed patches, hay meadows, alfalfa and sweet clover fields, grain fields, and similar locations. They are made in little hollows scratched in the soil, and are composed of grass and leaves. Ordinarily nesting takes place on low ground, but in case of heavy rains in April and May the birds are driven to higher ground for a later nesting. This was true in Valley county in 1929, when the spring hatch was reduced by the wet weather. The eggs are ovate, rounded at the smaller end, and plain buff or greenish buff in color, without markings. They are about $1\frac{1}{3}$ by $1\frac{3}{4}$ inches in size. Incubation begins when the setting is complete, and is as a rule per-

formed entirely by the hen pheasant. The normal incubation period is 23 days, but it may be lengthened if the eggs get chilled.

The young are brooded by the mother for a day or somewhat less, soon after which she leads them away in search of food. Usually the mother alone cares for the young until they are 6 or 7 weeks old, after which the male may take charge of them while the female starts a second nesting. The sexes become distinguishable about the time the chicks are 5 or 6 weeks old, the males showing some bare skin on the side of the face and certain plumage color differences. The birds stay chiefly in the cover of the corn fields, hay meadows, and weed patches, very few venturing out in the stubble fields. The approaching end of the nesting season, in August, finds the old birds abandoning their young, going about singly, and becoming much more wary and alert for danger, and hard to see. Flocks of young pheasants are frequently seen in the weed patches, roadsides, and corn fields. In September and October they all frequent the weed patches and brush, within feeding range of the corn fields, which continue to be the center of their interest thru the fall and winter.

While the pheasants will live and breed in a great variety of situations, they are by nature a cover-inhabiting bird. They like brushy thickets, dense weed patches, hay meadows, or corn or other fields bearing a heavy cover that will provide for their concealment, in the vicinity of open fields for foraging during their feeding periods. The females especially seek cover. They are not woodland birds. Pheasants require plenty of water, and are usually found not very far away from a supply of it. They feed most actively twice a day, during the early hours of the morning shortly after sunrise and during the last few hours before dark. At midday their crops are usually empty or nearly so. During the nesting season the birds, and especially the females, apparently feed quite locally. At other times they forage widely for their food. This is especially true during the winter, when they may shift about in relation to food supply, being at times scarce or absent over considerable areas but present in large numbers at other places. Some unshucked corn fields, or fields where corn is being hogged down and waste grain is plentiful, may attract them in abundance. They also may come into the farmer's barnyard and associate with his chickens. They usually roost at night on the ground, preferring a sloping place sheltered from the wind that offers a quick flight to thickets lower down.

It seems that wherever in the United States the pheasant has been introduced and has thrived, as soon as it has become abundant its status in relation to agriculture has become a live question, with contradicting points of view among the farmers of that region. In this, Nebraska has been no exception. The ring-necked pheasant has both friends and enemies among the farmers and ranchmen of Nebraska.

REGION IN NEBRASKA FROM WHICH COMPLAINTS OF DAMAGE BY PHEASANTS HAVE COME

Complaints relative to depredations by pheasants in Nebraska have not come uniformly from all of the counties where these birds occur, but more especially from a block of 16 counties in the east-central part of the state where the birds have found conditions favorable for building up a relatively large population. This block has Valley and Sherman counties for its center, these being in the heart of the region where the pheasant is the least popular among the farmers. The other counties in which the pheasant is more or less commonly complained of by farmers are Buffalo, Hall, Howard, Greeley, Merrick, Nance, Boone, Antelope, southern Holt, Wheeler, Garfield, Loup, Blaine, and Custer. These counties are shown by crosshatching on the accompanying map (Fig. 3). A few complaints have also come from just east of this block of counties—that is, from Pierce, Madison, Platte, Polk, and Butler. In the other counties, except Garden and Morrill, the pheasant seems not to have become numerous enough to provoke complaints of serious injury to crops.

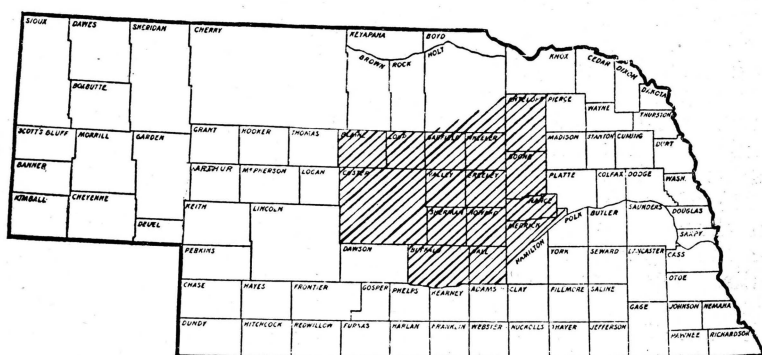


FIG. 3.—The block of 16 counties in east-central Nebraska in which the pheasant is most numerous and has been most complained of as injurious to crops. (Original.)

PLAN OF THE PRESENT INVESTIGATION OF THE FOOD OF THE PHEASANT

Because of the controversial claims and counterclaims regarding the food habits of the pheasant in Nebraska, and in order to secure facts upon which definite conclusions as to the true status of this imported bird in the state might be reached, at the request of Mr. Frank B. O'Connell, then Chief of the Bureau of Game and Fish of the Nebraska State Department of Agriculture, and of Secretary of Agriculture H. J. McLaughlin, in January, 1929, the Nebraska Agricultural Experiment Station authorities approved a project to determine the nature of the food of the adult ring-necked pheasant during the year in east-central Nebraska.

It would require an analysis of the crops and gizzards of several hundred pheasants, taken in many localities and habitats and at all seasons, to provide sufficient data for an exactly accurate picture of the food habits of the bird thru the year. Such an extensive and costly study being impractical under existing conditions, it was felt that a more limited number of pheasants, taken in properly varied habitats and representing all seasons, in a typical general locality, would provide sufficient data for a fairly accurate cross-section of the food habits of this bird. Valley county is centrally located in that part of the state from which the bulk of the complaints concerning injury to crops by pheasants have emanated. Accordingly, the pheasants were all taken in the 12 eastern townships of the 16 townships in that county, with the city of Ord in their approximate center, by Mr. Jess A. Kovanda, of the Ord City Schools, under a special permit issued by Mr. O'Connell. Eight pheasants were collected in each month of 1929, except in May and June, while and shortly after the corn was sprouting, when 10 birds were taken, making exactly 100 pheasants in all. These 100 birds were divided equally as to sex—50 cocks and 50 hens—and, so that all habitats might be represented, they were taken as nearly as possible upon the basis of about one-half (45) of the birds from the "lowland", or stream bottom lands in the valleys, and about one-half (55) from the "upland", or the higher surrounding lands and ravines between the hills. The accompanying map (Fig. 4) shows the district in Valley county in which the pheasants were collected, the "lowland" (white) and "upland" (dotted) areas of the same, and the place within these areas where each of the 100 pheasants was taken.

The exact dates and the number and sex of the birds taken on each day are as follows:

Date	Males	Females	Date	Males	Females	Date	Males	Females
Jan. 5	2	..	May 29	1	2	Sept. 4	1	2
Jan. 12	3	..	June 5	2	2	Sept. 21	..	1
Jan. 19	2	1	June 8	3	2	Sept. 26	2	..
Feb. 16	1	2	June 10	..	1	Sept. 28	1	1
Feb. 20	3	..	July 15	..	1	Oct. 14	3	1
Feb. 23	..	2	July 16	2	1	Oct. 19	1	..
Mar. 16	1	4	July 22	1	..	Oct. 21	..	1
Mar. 23	..	1	July 23	1	..	Oct. 26	..	2
Mar. 25	..	1	July 29	1	1	Nov. 5	2	..
Mar. 26	..	1	Aug. 9	1	..	Nov. 16	2	..
Apr. 3	1	1	Aug. 15	1	..	Nov. 23	..	1
Apr. 6	2	1	Aug. 16	..	1	Nov. 30	1	2
Apr. 13	1	2	Aug. 17	1	..	Dec. 6	3	2
May 25	2	3	Aug. 18	..	1	Dec. 7	..	3
May 27	2	..	Aug. 20	..	3			

After the pheasants were taken, they were immediately sent by express to the Department of Entomology of the Experiment Station, where each bird was given a number and its crop and gizzard were removed. The contents of each crop and gizzard were removed separately, and each carefully sorted into their constituent items, which were weighed accurately down to one one-hundredth of a gram. Inasmuch as food remains in the crop of the pheasant for only a relatively short time, and is very little changed while there, the percentages of different food materials have been computed entirely on the basis of the weights of the contents of the 100 crops. In the gizzard the food is ground up, often very finely, and the softer elements, like leaves, fruit pulp, or insect larvae, soon become unidentifiable and pass on into the intestines, while a large part of the hard seeds and the more heavily chitinous portions of the insect may remain in the gizzard, along with the gravel and other hard materials picked up with the food, for an indefinite time. The gizzard contents, therefore, while supplementing the crop contents by throwing much additional light on the range of the food of the bird, cannot fairly be included in the computations to determine the relative amount of each item in the daily food of the pheasant, as they would unduly increase the importance of the harder types of food.

THE FOOD HABITS OF THE PHEASANT IN OTHER STATES

Before proceeding to a detailed analysis of the year's food of these 100 Valley county pheasants, it is desirable for purposes of comparison to summarize briefly the findings of other investigators as to the food of the pheasant in other parts of the United States. Local studies of this sort have been made in the Pacific Northwest and in Massachusetts, Colorado,

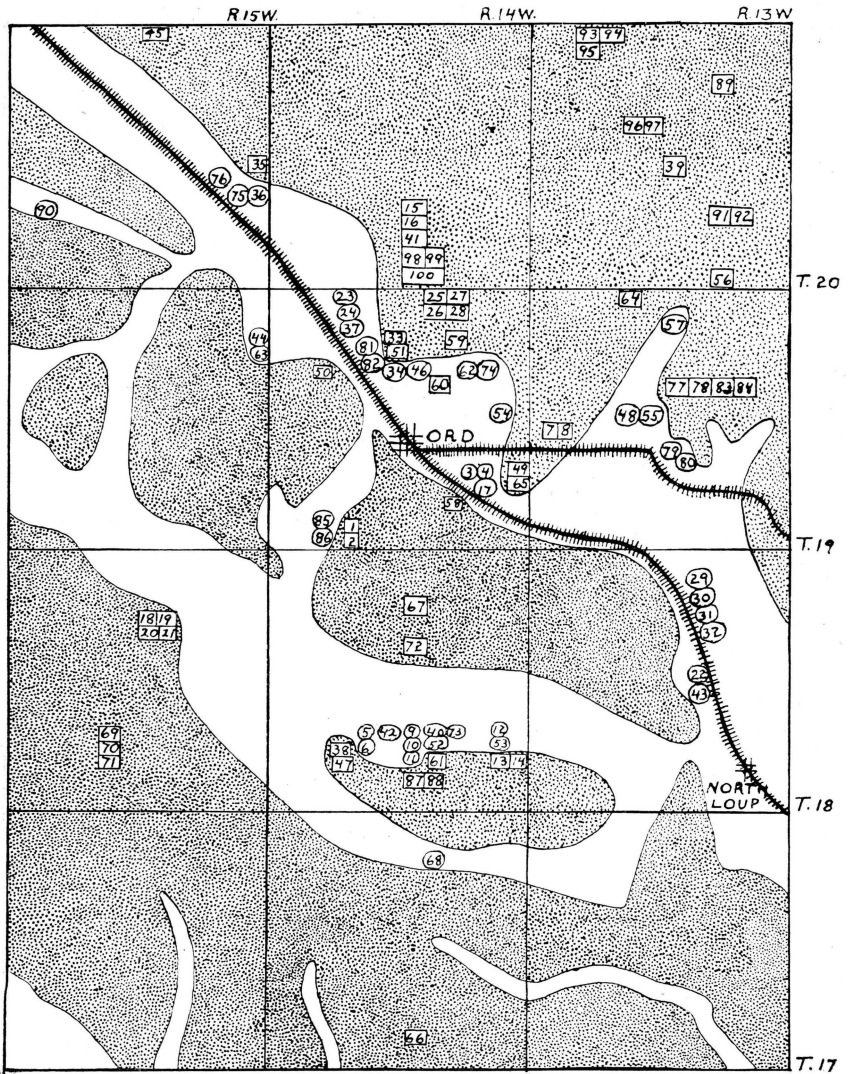


FIG. 4.—Map of the 12 eastern townships of Valley county, Nebraska, from which the 100 pheasants used in this study were collected. White areas represent “lowland” and dotted areas “upland”. The place where each of the 100 pheasants was taken is represented by its number, those of the “lowland” birds in circles and those of the “upland” birds in squares. (Original.)

Utah, and South Dakota, the three last-mentioned studies being especially pertinent to those made in Nebraska.

FOOD HABITS IN THE PACIFIC NORTHWEST

McAtee and Beal (2) in 1912 gave a brief report on the economic status of the ring-necked pheasant in America, based on farmers' reports of damage and particularly on the examination of 14 stomachs from the Pacific Northwest. The birds were accused by New York farmers of digging sprouting corn, oats, barley, beans, and cucurbit seeds, and of being unfriendly to domestic poultry. On the other hand farmers in Oregon and Washington had no complaint to make, and valued pheasants highly. The stomachs of 12 pheasants collected in Oregon and Washington contained oats and wheat to the extent of about 34 per cent of their total contents, and in the case of two pheasants from British Columbia, these grains constituted 82.5 per cent of the total food. From 200 to 960 kernels of wheat and oats were taken by various birds. It was believed that this was largely waste grain, because all of the birds were taken in September, October, and December. One stomach contained 200 refuse peas, another 23 acorns and 200 pine seeds, and a third about 800 capsules of chickweed (*Alsine* sp.) containing more than 8,000 seeds. Other vegetable matter included browse, rose hips, snowberries (*Symphoricarpos racemosus*) and seeds of dandelion (*Taraxacum taraxacum*), lupine (*Lupinus* sp.), bur clover (*Medicago denticulata*) and black mustard (*Brassica nigra*). March fly (*Biblio*) larvae were heavily eaten, one stomach containing 432 and another 360 of these maggots. The evidence showed that pheasants were gross feeders, with great capabilities for good in destroying insects or for harm in destroying crops. The authors concluded that the economic status of the pheasant was a local problem, depending on the proportion of land under cultivation, the kinds of crops raised, and the quantity of wild food available, with the chances about even for their becoming a useful or harmful factor in agriculture.

FOOD HABITS IN MASSACHUSETTS

Field, Graham, and Adams (3) in Massachusetts reported in 1914 that during the preceding two years numerous complaints had been made relative to damage to farm crops by pheasants. Of these, 21 complaints were of damage to corn, 15 to garden truck, 3 to peas, 2 to tomatoes, 2 to fruit, and 1 to potatoes. Others reported that the pheasants, tho numerous, had done no appreciable damage to crops. Contents of stomachs of pheasants shot while supposedly damaging

gardens or farm crops showed grain (all waste except in one instance) 22 per cent, weed seeds 23 per cent, tomatoes 21 per cent, insects 15 per cent, undetermined or of no economic importance 19 per cent.

FOOD HABITS IN COLORADO

Burnett (4) in 1921 reported on the crop and gizzard contents of 48 pheasants taken in Larimer and Weld counties, north-central Colorado, in March, 2; April, 6; May, 6; June, 4; July, 3; August, 5; September, 6; October, 2; November, 9; and December, 5; 1920. Of these 48 pheasants, 31 were males (27 adults and 4 young or immature birds) and 15 were females (10 adults and 5 young or immature birds), while 2 were young birds, undetermined as to sex. Most of the birds (31) were taken in the vicinity of Fort Collins, tho 5 each were taken at Windsor and Waverly, 4 at Loveland, 2 at Wellington, and 1 at Ault. This report was not made in percentage form.

Grain was found in pheasants taken in every month in which any were collected. Of the entire 48 birds, 28 had eaten 5,517 kernels of wheat, 8 had eaten 546 kernels of corn, 6 had eaten 634 kernels of barley, and 6 had eaten 342 kernels of oats, a total of 7,039 kernels of grain, or an average of 146.6 kernels of grain for all of the birds taken, excluding all fragments of grain. In 28 of the birds examined, a total of 2,127 weed seeds were found, as follows: Sunflower (*Helianthus* sp.), 555 seeds; black bindweed (*Polygonum convolvulus*), 482 seeds in 8 birds; green foxtail grass (*Chaetochloa viridis*), 292 seeds in 3 birds; smartweed (*Polygonum* sp.), 206 seeds in 1 bird; black mustard, 170, and white mustard (*Sinapis alba*), 165 seeds in 8 birds; black nightshade (*Solanum nigrum*), 145 seeds in 2 birds; wild oats (*Avena fatua*), 69 seeds in 5 birds; giant ragweed (*Ambrosia trifida*), 30 seeds in 4 birds; Indian bread-root (*Psoralea hypogaea*), 12 seeds in 4 birds; and lady's thumb (*Polygonum persicaria*), 1 seed in 1 bird. Alfalfa leaves were considerably eaten as green food. Other vegetable material found included dandelion buds, cherry pits, nightshade (*Solanum nigrum* and *S. triflorum*) berries, pinto beans, and vetch (*Vicia* sp.) seed.

The 48 birds ate 788 insects. The largest number of any species was 558 alfalfa webworms (*Loxostege commixtalis*), taken by 3 birds (335, 222, and 1, respectively), these larvae having been very abundant in the fields in 1920. Eleven of the related sugar-beet webworm (*Loxostege sticticalis*) were eaten by 3 birds. Altho cutworms (*Noctuidae*) were common in the fields, only 1 pheasant had eaten them, to the extent of 3 worms. Beetles were eaten to the extent of 163 individuals. Leaf beetles (*Chrysomelidae*) were favorites, and

included 26 beet leaf beetles (*Monoxia puncticollis*), 12 Colorado potato beetles (*Leptinotarsa decemlineata*), 32 beetles of the sunflower leaf beetle (*Zygogramma exclamationis*), 6 of the related *Zygogramma conjuncta*, 9 flea beetles of the species *Systema bitaeniata*, and 1 of the marsh-inhabiting *Phyllobrotica decora*. Curculios (*Graphorhinus vadosus*, *Baris* sp., *Thecesternus humeralis*, etc.) were also freely taken, to the number of 14. Other beetles taken were the dung beetle *Aphodius inquinatus*, 17, *Diplotaxis haydeni*, 8, and other Scarabaeidae, 5; the tenebrionid beetles, *Trimyctis pruinoso*, 2, *Eleodes extricata*, 1, *Eusattus difficilis*, 9, and *Blapstinus* sp., 8; the melyrid beetle *Collops vittatus*, 2; the rove-beetle *Paederus littorarius*, 8; and a click-beetle (Elateridae). Of the above-named 86 leaf beetles, 48 were regarded as of injurious species, the other 113 beetles being regarded as neutral species. Beneficial beetles eaten were ground-beetle larvae and an adult ground beetle (*Harpalus* sp.), and a carrion beetle (*Silpha ramosa*). Only 7 grasshoppers were eaten, and 3 of these were old dry ones, picked up dead. Forty ants were found in these stomachs. One stomach contained a fly puparium. Other insects identified include one each of the black-spotted willow aphid (*Lachnus dentatus*), the alfalfa treehopper (*Campylenchia curvata*), and the superb plant bug (*Calocoris superbus*), an enemy of alfalfa. A single spider was also found in one of the stomachs.

Maxson (5) reported also in 1921 on the crop and gizzard contents of 11 male pheasants taken near Longmont, Boulder county, Colorado, in May, 2; June, 5; September, 1; October, 1; and December, 2; 1916. His report also was not made in percentage form. It showed, however, that the food of the pheasant in that locality was largely composed of vegetable matter, this being at least twice the bulk of the animal matter taken in those months when insects were most eaten. The vegetable matter consisted largely of grain, including corn, wheat and its chaff, oats, and barley. The corn crop was more injured than any other because of the corn-pulling habit of the pheasant, this having resulted in several instances in the complete destruction of the stand over considerable areas. The pheasants showed a liking for tomato fruits and nightshade berries. They also ate young seedling sugar beets and the pulp of seed beets and commercial beets in the fall. Green food eaten included the leaves of alfalfa, nightshade, lamb's-quarters (*Chenopodium album*), and buttercup (*Ranunculus* sp.). Seeds eaten included smartweeds (*Polygonum* spp.), foxtail grass, amaranth (*Amaranthus* sp.), dock (*Rumex* sp.), orache (*Atriplex* sp.), Russian thistle (*Salsola tragus*), sunflower, ragweed, and Rocky Mountain bee plant (*Cleome*

serrulata). No foundation was found for the statements that the pheasant is a great enemy of grasshoppers, tho 18 grasshoppers were found in the birds examined. Beetles of various kinds were commonly eaten, including ground beetles (Carabidae), a tiger beetle (*Cicindela* sp.), click beetles, leaf beetles, white grubs (*Phyllophaga* sp.), and a blister beetle (Meloidae) larva. Among the leaf beetles, the Colorado potato beetle was found in two birds, indicating that where potatoes are extensively grown the birds might render their service in the destruction of these pests. No cutworms were found. One pheasant contained portions of an earthworm. Taking the contents of the 11 birds as a whole, 5 birds would be classed as injurious, 4 as beneficial, and 2 as neutral.

FOOD HABITS IN UTAH

Cottam (10) in 1929 reported in detail on a very careful analysis of the contents of the crops and gizzards of 45 ring-necked pheasants collected in 1928 in various important agricultural areas in Utah county, Utah, especially on farms where they were reported as doing damage to crops. These 45 birds were distributed thru the year as follows: January, 2; February, 2; March, 4; April, 2; May, 1; June, 1; July, 2; August, 1; September, 5; October, 4; November, 19; and December, 2. The contents of these stomachs showed that in Utah the pheasant is an omnivorous feeder, with grain as its favorite food. Thirty-three of the 45 birds had eaten grain, 29 of them having been collected in or near grain fields. Most of the grain was waste, tho some sprouting grain was taken. The food for the year was 85.5 per cent vegetable matter and 14.5 per cent animal matter. Fifteen of the 45 birds (all taken in the fall and winter) contained 100 per cent of vegetable matter in the crops and gizzards. Thirty-seven contained over 90 per cent of vegetable material, but only 1, a one-third grown chick, contained over 90 per cent of animal matter. Only 7 of the 45 birds had eaten more than 10 per cent of animal matter.

The vegetable matter included 36.7 per cent of grain (of which 79.7 per cent was wheat, 10 per cent corn, 10 per cent barley, and .3 per cent oats), 20.4 per cent of green plant material (including grass, alfalfa, clover, aquatic plants, buds, beet and lamb's-quarters leaves), 9.5 per cent of weed seeds (of 36 kinds, including smartweed, green foxtail grass, sweet clover (*Melilotus alba*), wild rose, dock, barnyard grass (*Echinochloa crus-galli*), mustard, sunflower, Russian thistle, ragweed, etc., in the order given), 5.5 per cent of fruit and vegetables (sugar beets, tomatoes, peas, cherries, apples, grapes), and 13.4 per cent of miscellaneous and unidentified

vegetable matter. The animal food consisted of about 40 kinds of insects, and included 5.8 per cent of Orthoptera (chiefly grasshoppers, including 7 species), 4.1 per cent of Coleoptera (13 species, mostly bill-bugs (*Sphenophorus*) and other snout-beetles, ground beetles, *Aphodius* dung beetles, and click-beetles), 2.8 per cent of Hymenoptera (nearly all ants of the genus *Formica*), and 1.8 per cent of miscellaneous and unidentified animal matter. Animal matter varied in different birds from a mere trace to 96.4 per cent of the contents. At no time of the year was the adult pheasant predominantly insectivorous. Seventeen birds had eaten grasshoppers; 16, beetles; 6, ants; and 6, cutworms.

Considering only the 33 crops and gizzards taken from October to March, inclusive, the vegetable matter averaged 96.1 per cent of the food for those six months (varying from 89.7 per cent in October to 99.2 per cent in March), of which 47.2 per cent was grain (varying from 24.2 per cent in March to 62.5 per cent in October), 16.4 per cent was weed seeds (varying from 1.6 per cent in February to 44 per cent in January), 8.6 per cent was fruit and vegetables (nearly all taken in December, when they formed 48.7 per cent of that month's food), 5.7 per cent was green plant material (mostly taken in March, when it formed 20.8 per cent of that month's food), and 18.2 per cent was miscellaneous and unidentified vegetable material. For the same six months the animal matter averaged 3.8 per cent of the total food, with Orthoptera forming 1.9 per cent (taken almost entirely in October), Coleoptera .3 per cent (taken in October, November, and March), Hymenoptera .1 per cent (taken in October and February), and miscellaneous unidentified animal matter 1.3 per cent.

Similarly considering only the crops and gizzards of 12 birds taken from April to September, inclusive, the vegetable matter averaged 74.6 per cent of the food for those six months (varying from 50.1 and 53.7 per cent, respectively, in July and May, to 91 and 96 per cent, respectively, in June and August), of which 35.2 per cent was green plant food (taken chiefly in April, May, and June, when it formed, respectively, 69.5, 53.7, and 68 per cent of the food of these months), 26.2 per cent was grain (varying from little or none in April, May, and June to 47.9, 79, and 29 per cent, respectively, in July, August, and September), 2.8 per cent was weed seeds (almost all taken in September, and forming 12.3 per cent of that month's food), 2.3 per cent fruit and vegetables (all taken in September, and forming 14.2 per cent of the food of the month), and 8.4 per cent was miscellaneous and unidentified vegetable material. For the same six months the animal

matter averaged 25.2 per cent of the total food, with Orthoptera forming 9.7 per cent (taken chiefly in July and September when they formed 36.9 and 14.8 per cent of the food of those months), Coleoptera 7.6 per cent (taken chiefly in April and May, when they formed 21.7 and 16.7 per cent of the food of those months), Hymenoptera, 5.6 per cent (almost all taken in May and forming 29.6 per cent of that month's food), and miscellaneous and unidentified animal matter 2.1 per cent.

FOOD HABITS IN SOUTH DAKOTA

Early in 1929 the Department of Entomology and Zoology of the South Dakota State College of Agriculture and Mechanic Arts, at Brookings, began a state-wide study of the economic status of the pheasant in that state. This study includes not only an analysis of the contents of the crops and gizzards of 500 or more pheasants but also a field study of the food habits of the birds. No complete report on this study has been published, but reports have been given out on the contents of a few of the birds examined, thru an article in *Outdoor America* by Brown (14) and in other sports publications. For example, the crop and gizzard of one taken early in the spring, while snow was yet on the ground, contained 261 kernels of oats, 151 of barley, and 17 of wheat, and 1,626 seeds of yellow foxtail grass, 50 of green foxtail grass, 98 of sweet clover, 17 of wild buckwheat, 9 of wild rose, 5 of Russian thistle, and 2 of lamb's-quarters. The crop and gizzard of another killed while eating corn in a highway contained corn almost exclusively, the only other food being 5 yellow foxtail-grass seeds and 4 wild buckwheat seeds, with a few parts of insects. In another taken in a field of young corn the crop and gizzard contained 65 kernels of unsprouted (probably waste) corn, 26 of oats, 7 of barley, 1 of wheat, 1 yellow foxtail-grass seed, 63 cutworms, and 1 spider. Another had eaten 277 maggots, 5 kernels of wheat, 2 seeds of wild sunflower, and 1 seed each of yellow foxtail grass, green foxtail grass, and knotweed; another, 580 kernels of old waste wheat; another 11 kernels of corn, 12 of barley, and 4 of oats; and still another 79 kernels of wheat and 53 weed seeds.

FOOD HABITS IN THE UNITED STATES IN GENERAL

Leffingwell (8) reported in 1928 on the food habits of the ring-necked pheasant, based on analyses of the stomach contents of an unstated number of birds from various parts of the United States. His report may be summarized as follows. Pheasants seem to feed on whatever is easiest to obtain. The food of these birds consists in general of weed seeds, insects, and cultivated crops. In weedy areas or insect-

infested patches they do good, while in grain fields they do damage. Of cultivated crops the cereal grains, and especially corn, are preferred. Altogether the seeds and fruits of 14 kinds of cultivated crops are known to be eaten by pheasants. The seeds or fruits of 101 species of wild plants were found in the stomachs of pheasants. Of these 40 were the seeds of weeds, 59 of plants of neutral value, and 2 were wild fruits—the wild raspberry and wild black cherry. The three kinds of weed seeds most commonly eaten were those of foxtail grass, ragweed, and smartweed. More than 10,000 seeds of foxtail grass, 7,500 of ragweed, and 5,000 of smartweed were in the stomachs examined. One pheasant stomach contained more than 5,000 seeds of foxtail grass.

In the vicinity of Ithaca, New York, where much of the land is weedy, Eaton found that 76 pheasants had eaten the seeds of amaranth, yellow foxtail grass, goosefoot (*Chenopodium* spp.), ragweed, burdock (*Arctium* spp.), and various species of smartweed. The general belief is that in the summer pheasants eat chiefly grasshoppers, June beetles, and caterpillars. One reporter wrote that he found 47 grasshoppers in the crop of a pheasant. The crops of two pheasants killed in Oregon on November 1 and examined by Mr. W. L. Finley contained, respectively, 34 grasshoppers, 3 crickets, 8 beetles, and 280 weed seeds, and 303 cutworms and 60 blue bottle fly maggots. Of the insect food actually found in the stomachs examined by Leffingwell, however, beetles (Coleoptera) formed the largest portion, 417 individuals representing 42 species being found. The only beneficial insect commonly eaten was the tiger beetle, *Cicindela sexguttata*. Nine species of Lepidoptera (moths), 8 species of grasshoppers and crickets (Orthoptera), and 26 species of other insects and invertebrates made up the remainder of the animal food. A Minnesota reporter credits pheasants with destroying mice.

SUMMARY OF THE YEAR'S FOOD BASED ON THE CROP CONTENTS OF 100 NEBRASKA PHEASANTS

The results of the analyses of the crop (and gizzard) contents of the 100 Valley county, Nebraska, pheasants may now be considered in detail. The food of the ring-necked pheasant as revealed in these analyses consisted on the whole of vegetable matter, such as grains, seeds, pods, berries and plant debris, and of animal matter, such as insects, spiders, millipedes, earthworms, snails, and small vertebrate animals. With this food material proper there was also, of course, a certain amount of undigestible dirt and gravel. Of the 100 crops examined, 44 contained 100 per cent of vegetable mat-

ter; 43 contained vegetable matter with more or less animal matter intermixed; and 13 (Nos. 12, 13, 20, 23, 30, 43, 45, 53, 81, 83, 84, 91, and 100) were completely empty. None of the crops contained animal matter exclusively, altho one female bird (No. 44) taken on June 5 had a number of beetles, caterpillars, and snails, with a spider and fragments of a millipede in her crop, totaling 5.21 grams, with only .08 gram of vegetable debris and yellow foxtail-grass seed present.² The 44 crops containing only vegetable matter were taken at all seasons, while the 43 that contained some animal matter were all taken between March 16 and December 6, except for two early January birds (Nos. 1 and 2) that had a ground beetle and a grasshopper leg, respectively, in their crops.

Of the 87 crops containing food, 68, or 78.2 per cent, contained more or less grain, which was taken at all seasons of the year but especially during the winter. Of these 68 crops containing grain, 23 contained corn alone. Five each contained popcorn alone; corn and oats; and corn, oats, and barley. Four contained corn and wheat and four contained oats alone. Three contained only barley. Two each contained corn and popcorn; corn, popcorn, and oats; corn, popcorn, and barley; corn, oats, wheat, and barley; oats, wheat, and barley; and oats and barley. One each contained corn and barley; corn, popcorn, oats, wheat, and barley; corn, popcorn, oats, and barley; corn, oats, wheat, and rye; corn, oats, wheat, barley, and cane; popcorn and barley; and popcorn, oats, and barley. In these 68 crops containing grain there were 1,465 whole kernels of corn, 859 of popcorn, 1,691 of oats, 485 of barley, 368 of wheat, 78 of cane, and 1 of rye. In addition, there was an abundance of fragments of corn and other grain. Taking only the whole kernels into consideration, that would be an average of 22 kernels of corn, 13 of popcorn, 25 of oats, 7 of barley, 5 of wheat, and 1 of cane for each one of the 68 grain-eating birds. The number of corn kernels eaten varied in different individual crops from 1 to 178; of popcorn kernels from 2 to 269; of oats from 1 to 508; of barley from 1 to 148; and of wheat from 1 to 142. The maximum count of oats and barley kernels occurred in the same crop (No. 60).

² On April 8, 1930, a male pheasant was killed by flying into the front of a car driven by Mr. George C. Porter of Morrill, Scotts Bluff county, 10 miles northwest of that place. Mr. Porter picked it up, and, cutting open the crop, found that it was full of worms. He promptly sent the entire contents of this crop to the Department of Entomology at the College of Agriculture, and on closer analysis these contents were found to consist of 122 large western army cutworms (*Euxoa auxiliaris*), weighing 57.84 grams, along with 2 grains of barley, 1 grain of oats, and a few unidentified seeds with a little vegetable debris, this vegetable matter altogether weighing but .22 gram. These 122 cutworms were undoubtedly picked up in a nearby alfalfa or wheat field, there being an abundance of this cutworm in western Nebraska in the spring of 1930. This well illustrates the gross feeding habit of the pheasant and its capacity to destroy noxious insects when they are secured easily in large amounts.

The cane and rye all occurred in a single crop each (Nos. 8 and 64, respectively). In the gizzards of these same 68 birds there were found in addition 131 whole kernels of corn, 69 of popcorn, 104 of oats, 94 of barley, 65 of cane, and 51 of wheat.

Of the 19 crops that contained no grain, 17 were nearly empty, containing a total of less than 1 gram of vegetable matter. This matter in 8 crops (Nos. 3, 39, 40, 47, 51, 86, 89, and 99) consisted entirely of vegetable debris, varying in quantity from .02 to .34 gram; in 5 crops (Nos. 10, 11, 71, 72, and 75) consisted of from .01 to .26 gram of weed seed; in 3 crops (Nos. 44, 76, and 82) of from .08 to .74 gram of vegetable debris and weed seed mixed; and in 1 crop (No. 85) of .04 gram of vegetable debris and a fly pupa. The two crops that were fairly well filled both contained vegetable debris and weed seeds mixed, to the extent of 5.64 grams (No. 52) and 9.58 grams (No. 87).

PERCENTAGES OF VARIOUS FOODS IN THE 100 PHEASANT CROPS

VEGETABLE MATTER

On the basis of percentages by weight, the digestible (non-mineral) food in the 100 crops examined was found to consist of 89.09 per cent of vegetable matter and 10.91 per cent of animal matter. The preponderant part of the vegetable food, as has been indicated, was cultivated grains, chiefly corn. Cultivated grains formed 76.14 per cent, vegetable debris formed 5.37 per cent, weed seeds 4.10 per cent, grass seeds 2.02 per cent, and other seeds, seed pods, and berries 1.46 per cent of the year's food.

Corn, including popcorn, was the most important single item in the pheasant's diet. It alone formed 67.09 per cent of the year's food, and was eaten during every month of the year. The heaviest corn consumption came in the month of January, when it was eaten to the extent of 96.41 per cent of the food of that month, or 19.10 per cent of the food of the year. Corn was heavily consumed during February and April also (forming 89.40 and 84.93 per cent, respectively, of the food of those months), tho in March it dropped decidedly (to 48.88 per cent), along with a sharp temporary increase in the consumption of small grains and the seeds of smartweed and ragweed. There was a decided decline in corn consumption in May (to 64.55 per cent of that month's food), and it reached the lowest point in June (when the consumption of May beetles, cutworms, and other insects was at its height), amounting to 17.16 per cent of that month's food. Corn con-

sumption continued at a relatively low level during July and August (amounting to 26.34 and 23.25 per cent, respectively, of the food for those months), and then in September abruptly increased to 78.11 per cent of the month's food. Receding slightly in October and November (the percentage for these two months being, respectively, 68.11 and 60.65), it again increased abruptly in December to form 89.25 per cent of the bird's food for that month.

It will be observed that corn consumption declined from over 80 per cent of the month's food in April to less than 65 per cent in May, and that it reached its lowest point in June. This fact indicates that the pulling of newly sprouted corn is not so attractive a method of securing that grain as is the picking up of waste kernels. Also, the corn found in the May and June crops was mostly unsprouted. Nevertheless, there is plenty of good evidence that the pheasant does pull newly sprouted corn. Mr. Kovanda saw cock pheasants pulling corn on two separate occasions in May, 1929. They would pass up several plants, then suddenly jerk one off. The one jerked off often had an insect burrow near it. Another cock pheasant was observed scratching in newly listed corn and picking up something. In June the spots where pheasants had been seen digging in the lister rows in May had no corn coming up, so it was believed that the pheasants probably got it. Several cock pheasants were seen scratching out corn. The hen pheasants apparently preferred the lister rows, where they could hide and find the corn more easily. They were not common in checked corn. One farmer protected his listed corn by scattering some shelled corn along the edge of his field. Damage by ground squirrels, cutworms, etc., may be wrongly charged to the pheasant.

Aside from corn, oats were the grain most eaten, forming 5.11 per cent of the food of the year. Oats were found in the crops of pheasants taken during each month of the year except February, October, November, and December. The amount eaten in January and September was trifling, forming less than 1 per cent of the month's food (.196 and .795 per cent, respectively). In March, April, and May oats formed between 1 and 2 per cent of the food for these months (1.98, 1.13, and 1.02 per cent, respectively). In June consumption of oats increased to 3.59 per cent of the month's food. July marked the high point in oats consumption when they formed 40.63 per cent of the food of that month. Oats were heavily consumed in August also, forming 28.60 per cent of the food for that month.

Next to oats, barley was the preferred small grain, forming 2.34 per cent of the food for the year. Barley was repre-

sented in the crops of pheasants taken during each month of the year except February, June, November, and December. In January, March, and October the amount of barley eaten was less than 1 per cent of the food of these months (.368, .286, and .178 per cent, respectively). In April and May barley formed between 1 and 2 per cent of the food for these months (1.31 and 1.05 per cent, respectively). As with oats, July marked the high point in barley consumption, constituting 15.71 per cent of the food of the month. Barley was fairly heavily eaten in August also, forming 12.28 per cent of that month's food, then dropping to 5.52 per cent of the month's food in September.

Wheat, including the chaff found, formed 1.45 per cent of the pheasant's food of the year. It was represented in the crops of birds taken in January, March, April, May, July, and August. In March, at spring-wheat sowing time, it formed 7.67 per cent of the month's food, and in July, at wheat harvest, it formed 6.75 per cent of the food of the month. In January, April, May, and August it formed less than 1 per cent of the month's food, the exact amounts being .063, .055, .209, and .408 per cent, respectively.

Cane and rye constituted, respectively, only .147 and .003 per cent of the year's food. Black amber cane was eaten only in January, when the crop of a male pheasant (No. 81) taken on upland on the nineteenth contained 78 grains of it (constituting .744 per cent of the month's food), along with 74 whole grains and fragments of corn, 17 grains of barley, 6 grains of oats, and 2 grains of wheat. Rye apparently is but rarely eaten. One grain was found (.081 per cent of the month's food), along with 14 grains of corn, 22 of oats, and 1 of wheat, in the crop of a male pheasant (No. 64) taken on upland ground on August 17.

It is interesting to note that the only grass seeds found in either the crop or the gizzard of these pheasants were those of grasses belonging to the tribe *Paniceae*, including the genera *Panicum*, *Echinochloa*, *Chaetochloa*, and *Cenchrus*. These constituted 2.02 per cent of the year's food, and were practically entirely the seeds of foxtail grass (*Chaetochloa*), the green species (*viridis*) being a little more freely eaten than the yellow one (*glauca*). Mr. Kovanda saw a cock pheasant picking up foxtail-grass seeds in August. Together, seeds of these two foxtail grasses constituted 2.00 per cent of the year's food, and were eaten every month in the year and constituted, respectively, 1.04, 13.96, 7.67, 14.49, and 2.64 per cent of the food for the five months of July, August, September, October, and November. In the seven other months these seeds were eaten in only trifling amounts.

Barnyard-grass seeds were eaten in trifling amounts in January, March, April, and September, and a few sand-burgrass (*Cenchrus tribuloides*) seeds were found in a single crop, that of a male bird (No. 93) taken on upland on December 6. Witch-grass (*Panicum capillare*) seeds were found in the gizzard contents of a male bird (No. 92) collected on lowland on November 30.

Of the weed seeds, those of smartweed (*Polygonum pennsylvanicum*) and other *Polygonums* (*convolvulus*, *persicaria*, etc.) were the most heavily consumed, constituting 2.07 per cent of the year's food. They were eaten to some extent in every month in the year except June, July, August, and September, but, except in March, when they constituted 24.55 per cent of that month's food, the amount was trifling. Sunflower (*Helianthus annuus*, etc.) seeds were next in favor, being eaten more or less in every month from October to May, inclusive, except that none were found in the March crops, but reaching an important volume only in November, when they constituted 14.63 per cent of the food of that month. The seeds of the giant ragweed were eaten in February, March, and April, but only in March to any important extent, forming 5.22 per cent of the March food. The seeds of the partridge pea (*Cassia fasciculata*) were found only in December crops, but then in such amounts as to constitute 4.53 per cent of the food of that month. A number of other weed seeds were eaten by the pheasant, but none of them constituted as much as one-tenth of 1 per cent of the year's food of the bird, so are not to be regarded as important. These include the seeds of buffalo-bur (*Solanum rostratum*), gromwell (*Lithospermum linearifolium*), false gromwell (*Onosmodium occidentale*), pigweed (*Amaranthus retroflexus*), sweet clover, beggar-ticks (*Bidens* sp.), milkweed (*Asclepias syriaca*) and Russian thistle. In the gizzards, seeds of common ragweed (*Ambrosia elatior*), bindweed (*Convolvulus* sp.), and spurge (*Euphorbia* sp.) were found, these being eaten chiefly and respectively in December and January, in December, January, and March; and in May.

Other seeds eaten by the pheasants were those of the osage orange (*Toxylon pomiferum*), which were eaten to the extent of .762 per cent of the January food and those of the elm (*Ulmus americana*), which were eaten to the extent of 4.47 per cent of the June food. The pods and seeds of the violet (*Viola pedatifida*) were eaten in May and June, only very slightly in the former month but constituting 1.16 per cent of the month's food in June. The pods and seeds of nyctelea (*Nyctelea nyctelea*) together formed 3.79 per cent of the pheasant's June food. The gizzard contents showed that

buttercup (*Ranunculus* sp.) seeds were freely eaten in May, that the seeds of Solomon's seal (*Polygonatum commutatum*) were eaten thru the year, and heavily consumed in June, and that the seeds of Virginia dayflower (*Commelina virginica*) were eaten from January to August. Wild raspberry (*Rubus occidentalis*) seeds were eaten to the extent of 2.48 per cent of the July food. Berries of the nightshade (*Solanum nigrum*) were eaten freely in October and November, forming 8.82 per cent of the pheasant's food for October and 1.71 per cent of its food for November.

Because of the quick digestion of the pulp and consequent early loss of identity in the crop, probably the nightshade berries and raspberry seeds found in the crop do not correctly reflect the quantity and diversity of wild fruit eaten by the pheasant. The seeds of fruits, collecting in the gizzard, probably give a somewhat better idea of this food item. In the gizzards examined were seeds of the wild prairie rose (*Rosa arkansana*), riverside grape (*Vitis vulpina*), poison ivy (*Toxicodendron radicans*), elder (*Sambucus canadensis*), wild raspberry, wolfberry (*Symphoricarpos occidentalis*), sandcherry (*Prunus besseyi*), and chokecherry (*Prunus virginiana*), the order given indicating the relative amount of each found. Fruit consumption was apparently lightest in September, when only a few wild rose apples were available, and the seeds were found in the gizzards. In October and November wild grapes were heavily eaten (continuing to be taken in small quantities until June), and the consumption of rose apples steadily increased to its maximum in the latter month. Poison ivy berries and wolfberries were eaten in November, the former being heavily consumed in January and February and on to April, the latter on to March. In December the wild fruit was rose apples and wolfberries, the former continuing to be eaten freely in January and then in reduced amounts until May. Sandcherries were eaten in May, June (maximum), July, and August in small amounts. Chokecherries were eaten in July, August (the maximum), and November. Raspberries were eaten in July only, and then quite freely. Elderberries were eaten in August only, in small amounts.

The material classified as vegetable debris was undoubtedly largely the foliage of various plants. Mr. Kovanda saw a hen pheasant pulling off the top of a corn plant in June, and two cock pheasants eating young sudan grass in July. They were reported to him as pulling out garden plants in July also.

ANIMAL MATTER -

Insects of various kinds comprised the bulk of animal matter, these collectively amounting to 6.33 per cent of the food of the year. Beetles (Coleoptera) and their larvae were the most eaten, forming 2.78 per cent of the year's food. Also in terms of the food of the year, grasshoppers and crickets (Orthoptera) constituted 1.53 per cent, caterpillars and moths (Lepidoptera) 1.06 per cent, maggots and flies (Diptera) .830 per cent, and ants (Hymenoptera) .044 per cent. The remaining insect food was bugs and miscellaneous other insects. Next to insects, earthworms (Oligochaeta) were the form of animal life most eaten, forming 2.76 per cent of the year's food and 13.57 per cent of the food eaten during May. They were sparingly eaten during April and June, also, but not in any other month. Toads (*Bufo* sp.) were eaten during June and July, forming 8.89 per cent of the food of the former month and .571 per cent of the year's food. Snails (Gasteropoda), eaten during April, May, and June (most heavily in May) formed .511 per cent of the year's food. Egg shells constituted .322 per cent, bone fragments .277 per cent, and millipedes (Diplopoda) and spiders (Araneida), .139 per cent of the food of the year.

The beetles and their larvae consumed by the pheasants included lamellicorn beetles (Scarabaeidae), ground beetles and their larvae, curculios (Curculionidae), click-beetles, darking beetles (Tenebrionidae), leaf beetles, long-horn beetles (Cerambycidae), hister-beetles (Histeridae), and death-watch beetles (Ptinidae). The lamellicorn beetles were eaten during April, May, June, and July, and included a number of species. The only one eaten in April was *Pseudaphonus pyriformis*, a rather uncommon beetle, which was represented in the crop of a male pheasant (No. 27) taken on upland on the sixth. In May, however, May beetles (*Phyllophaga* spp.), which are the adults of the destructive white grubs, the two-spotted vine chafer (*Anomala binotata*), which feeds on grape leaves, various species of harmless scavenger dung beetles (*Onthophagus hecate*, *Aphodius* spp., *Ataenius* sp.), and a carrion-eating skin beetle (*Trox aequalis*) were all eaten, and constituted, collectively, 3.87 per cent (respectively 1.46, 1.45, .907, and .049 per cent) of the food for that month. May beetles were consumed to the maximum extent in June, when they constituted 13.43 per cent of that month's food. In June a male pheasant (No. 49) taken on the eighth had the beetle *Cremastocheilus knochii* in its crop, and a few of the dung beetles *Onthophagus hecate* continued to be eaten during June and July.

In the ground-beetle family, several species of the genus *Harpalus* (*herbivagus*, *pennsylvanicus*, *erraticus*, etc.) were eaten in limited amounts at all seasons of the year. Together these constituted .294 per cent of the food of the year. The seed-corn beetle (*Agonoderus pallipes*), which attacks the planted corn kernels and young corn plants, was eaten in moderate numbers from March to June, inclusive. The consumption in April of a few of the predaceous ground beetles (*Bembidion* sp.) was offset by the destruction of primarily vegetarian forms, *Amara* sp. in April and *Anisodactylus harrisi* in May. Curculios, which were eaten during April, May, and June, composed 2.89 per cent of the food of June, and in May and June included the imbricated snout-beetle (*Epicaerus imbricatus*), which feeds on the leaves of fruit trees, corn, and vegetables, and the timothy bill-bug (*Sphenophorus parvulus*), which often injures corn when it is planted on sod ground. The gizzard of a pheasant (No. 41) taken on May 29 contained the related bill-bug *Sphenophorus melanocephalus*. Click-beetles (the adults of wire-worms) of several species, including *Limonius auripilis*, *Aeolus elegans*, *Monocrepidius auritus*, and *Hemicrepidius memnonius*, were eaten commonly, but not heavily, in May, June, and July. A female (No. 63) taken on lowland August 16 had five beetles of the injurious plains false wireworm (*Eleodes opaca*) in its crop. Leaf beetles eaten included principally the adults of the destructive western corn-root worm (*Diabrotica longicornis*), which were eaten in August and October, but also a few of the ragweed leaf beetle (*Zygogramma suturalis*) and the three-spotted beet flea-beetle (*Disonycha triangularis*) in May, and of the black-legged sweet-potato beetle (*Jonthonata nigripes*), and the striped sweet-potato beetle (*Metriona bivittata*) in June. The common long-horn beetle *Tetraopes femoratus*, the larva of which develops in the stems and roots of milkweed, was eaten by a female (No. 70) taken on upland on September 4. In May and June hister-beetles (*Hister ulkei*) were eaten by three different pheasants (Nos. 33, 36, and 46, all females), one of which (No. 46) also ate a death-watch beetle in June.

The belief that pheasants are habitually heavy consumers of grasshoppers was not borne out in this study. As before stated, grasshoppers and crickets constituted 1.53 per cent of the year's food. They were eaten chiefly from July to November, inclusive, forming, respectively, .810, 14.38, 7.16, 2.58, and 11.22 per cent of the food of these months. They constituted nearly all of the animal food eaten by the pheasant in November. Small dried legs and other fragments of dead grasshoppers were eaten in January, March, and April, but

these were only trifling in amount. The red-legged grasshopper (*Melanoplus femur-rubrum*) constituted nearly one-half of the Orthoptera consumed by the pheasant. The great bulk of the other approximate half of the grasshoppers and crickets consumed, and in almost equal amounts, were the two-striped grasshopper (*Melanoplus bivittatus*), lesser migratory grasshopper (*Melanoplus atlanis*), and field cricket (*Gryllus assimilis*). Altogether, short-horned grasshoppers comprised 1.29 per cent, and other Orthoptera, including field crickets, tree crickets (*Oecanthus* sp.), and meadow grasshoppers (*Conocephalus* sp.), only .24 per cent of the year's food.

All of the Lepidopterous food of the pheasant that could be definitely identified to the family, and that included 93 per cent of the total of it, was the larvae and moths of Noctuidae, and it is highly probable that much of the 7 per cent of unidentified Lepidopterous larvae and pupae was also Noctuid in nature. Cutworms of several species were eaten freely in May and June (maximum), and to a less extent in July, this item constituting 1.41, 7.61, and .987 per cent, respectively, of the food of these months. These cutworms included many of the most destructive corn-field cutworms in Nebraska, such as the dark-sided cutworm (*Euxoa messoria*), dingy cutworm (*Feltia ducens*), bronzed cutworm (*Nephelodes emmedonia*), greasy cutworm (*Agrotis ypsilon*), and granulated cutworm (*Feltia annexa*), the order given indicating the relative amount of each species consumed by the pheasant. The corn-ear worm (*Heliothis obsoleta*) and cutworm moths were found only in the crops of birds taken in October, and together formed 2.83 per cent of that month's food.

Of the maggots and flies consumed by the pheasant, the larvae of the March-fly *Bibio albipennis* were by far the most prominent in the crops examined. They occurred in birds taken in March, April, and November and constituted 4.62 per cent of the total April food. A tachina-fly (Tachinidae sp.) found in the crop of a female pheasant (No. 59), taken on upland July 29, was the only adult fly found in these studies. Evidently the pheasant is not quick enough to catch sufficient flies to make them any considerable part of its diet.

Field ants of several common species—*Prenolepis imparis*, *Formica rufa obscuripes*, *Formica fusca*, *Lasius niger neonigra* (the nurse ant for the corn-root aphid), and *Formica pallidefulva schaufussi incerta*—were found in the crops of the pheasants studied, but only in small quantities. They occurred in birds taken in March to July, inclusive, most numerous in April, when they formed .187 per cent of that

month's food. In the gizzard of a male pheasant (No. 48), taken on lowland on June 8, a single specimen of *Aphaenogaster fulva* was found.

Among the remaining insects identified among the crop contents of these 100 pheasants may be mentioned two species of true bugs (Hemiptera)—a damsel-bug (*Nabis ferus*) in July and a dusky plant-bug (*Adelphocoris rapidus*) in August. An assassin bug (Reduviidae sp.) was found in a gizzard of a female pheasant (No. 84) taken on upland on October 26.

The 100 birds examined did not furnish much evidence as to the alleged habit of pheasants' attacking and destroying the nests and eggs of other birds. Egg shells were found in the alimentary tract of 4 of the birds, as follows: in a female (No. 36) taken on lowland May 25, the crop of which contained .45 gram of egg shell and 1.32 grams of bone fragments, while there was .15 gram of bone fragments in her gizzard; in a female (No. 35) taken on upland on May 25 which had .08 gram of egg shell in the crop; in a female (No. 42) taken on lowland on May 29, the crop of which contained .08 gram of egg shell; and in a female (No. 52) taken on lowland June 10, the crop of which contained 1.34 grams of egg shell and .68 gram of bone fragments. The identity of the eggs could not be determined definitely from the fragments of shell. It will be noted, however, that all of these birds that had eaten eggs were females, taken during late May and early June, during the height of the pheasant hatching season. Both Oldys (1) and McAtee (7, 12) state that pheasants in pens easily develop the habit of eating eggs. This habit is usually begun by cock pheasants' eating broken eggs left in the pens, but the hen pheasants also readily acquire it. It is quite possible that these four females were incubating birds, and that they had eaten broken eggs from their own nests. In August, 1929, Mr. Kovanda placed a few chicken eggs in a path used by some old pheasants, and at the end of a fortnight the eggs had not been molested. Bone fragments were found in gizzards of three additional birds—.08 gram in a female (No. 31) collected April 13 on lowland, .52 gram in a female (No. 54) collected July 16 on lowland, and .13 gram in a male (No. 78) collected in October on upland. These bone fragments may have been those of young birds, but also may have been those of mice or other small mammals.

GENERAL CONSIDERATIONS

Whether the pheasant is to be classed as a bird that is beneficial or injurious to agriculture appears to be essen-

tially a local matter. It depends not only on the abundance of the birds, but also on the kinds of crops raised and the amount of wild food available in the locality in question. No general statement can be made covering all cases. The capacity of the bird for doing good or harm is great, because it tends to feed heavily on the most easily available, palatable foods. Probably its greatest capacity for harm is developed in grain-growing sections, in the fields of corn and small grains. The evidence is conclusive that in Nebraska, as in other grain-growing sections of the United States, the pheasant is dominantly a granivorous bird. However, with little doubt a large portion of the grain eaten by the Nebraska birds studied was waste grain, gleaned from the ground. Over 55 per cent (55.1) of the corn eaten was taken during the five months from December to April, inclusive, and nearly 75 per cent (74.9) of the small grains eaten was taken during July and August. The economic service performed by the pheasant in eating weed seeds is not very important, not only because the total amount eaten is not very great (about 6 per cent of the year's food), but because the number of weed seeds annually escaping destruction by the birds and all others of their natural enemies is probably more than sufficient to produce as great a weed stand as the conditions of natural competition and cultivation will permit to grow and mature. If the pheasant population is permitted to increase unrestrictedly in Nebraska, there will no doubt be increased injury to crops, and consequently augmented complaints by farmers; but if the birds are held down to reasonable numbers they will probably on most farms render a sufficient service by destroying injurious beetles, cutworms, grasshoppers, and other noxious insects as on the whole to balance, approximately, the harm they do to crops.

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