U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF ORNITHOLOGY AND MAMMALOGY

PRELIMINARY REPORT

ON THE

FOOD OF WOODPECKERS

BY

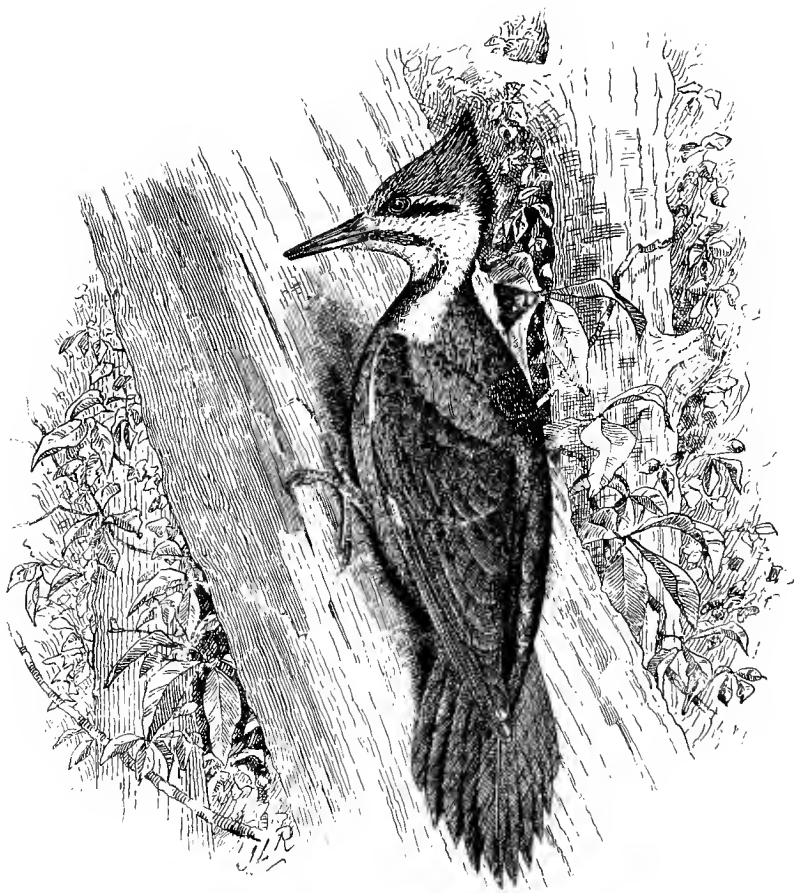
F. E. L. BEAL
ASSISTANT ORNITHOLOGIST

THE TONGUES OF WOODPECKERS

BY

F. A. LUCAS
CURATOR, DEPARTMENT COMPARATIVE ANATOMY
U. S. NATIONAL MUSEUM

WASHINGTON
GOVERNMENT PRINTING OFFICE
1895



PILEATED WOODPECKER OR LOGCOCK (*Ceophlœus pileatus*).

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., May 15, 1895.

SIR: I have the honor to transmit, as Bulletin No. 7 of this division, a preliminary report on the Food of Woodpeckers, by Prof. F. E. L. Beal, Assistant Ornithologist. The report is accompanied by a short article on the 'Tongues of Woodpeckers,' prepared at my request by Mr. F. A. Lucas, Curator of the Department of Comparative Anatomy, United States National Museum.

Respectfully,

C. HART MERRIAM,
Chief of Division of Ornithology and Mammalogy.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

Text figures.

Plates.

PRELIMINARY REPORT ON THE FOOD OF WOODPECKERS.

By F. E. L. Beal, *Assistant Ornithologist.*

GENERAL REMARKS.

With the possible exception of the crow, no birds are subject to more adverse criticism than woodpeckers. Usually no attempt is made to discriminate between the numerous species, and little account is taken of the good they do in destroying injurious insects. The name 'Sap-sucker' has been applied to two or three of the smaller kinds, in the belief that they subsist to a great extent upon the juices of trees, obtained from the small holes they make in the bark. There can be little doubt that one species, the Yellow-bellied Woodpecker (*Sphyrapicus varius*), does live to a considerable extent upon this sap. Observation does not show that other species have the same habit, but it is a difficult point to decide by dissection, as fluid contents disappear quickly from the stomach.

Many observers have testified to the good work these birds do in destroying insects, while others have spoken of harm done to fruit or grain. Both are correct within certain limits.

Field observation on the food habits of birds is attended with so many difficulties as to render it a very unreliable source from which to draw general conclusions. The most conscientious and careful person is often deceived, not only as to the quantity of a particular kind of food eaten by a bird, but as to the fact that it is eaten at all. The further difficulty of keeping a number of birds, or even a single one, under constant observation makes an estimate of relative proportions of different kinds of food impossible. When much mischief is done the fact is apparent, but there is no way to find out how much good is done during the same time. For these reasons it often happens that reports on food habits, based on observations of wild birds, not only conflict with each other but also disagree with the results obtained from stomach examinations. This last method must be taken as the court of final appeal, and it is evident that a collection of stomachs covering every month in the year, and as nearly as may be all points

of the birds' range, becomes more and more trustworthy as it increases in size; in other words, the more stomachs examined the nearer correct will be the result as to the birds' annual diet.

The present paper is merely a preliminary report, based on the examination of 679 stomachs of Woodpeckers, and representing only 7 species—all from the eastern United States. These species are the Downy Woodpecker (*Dryobates pubescens*), the Hairy Woodpecker (*D. villosus*), the Flicker or Golden winged Woodpecker (*Colaptes auratus*), the Red-headed Woodpecker (*Melanerpes erythrocephalus*), the Red-bellied Woodpecker (*Melanerpes carolinus*), the Yellow-bellied Woodpecker (*Sphyrapicus varius*), and the Great Pileated Woodpecker (*Ceophlœus pileatus*). Examination of their stomachs shows that the percentage of animal food (consisting almost entirely of insects) is greatest in the Downy, and grades down through the Hairy, Flicker, Pileated, Redhead, and Yellow-bellied to the Red-bellied, which takes the smallest quantity of insects. Prof. Samuel Aughey stated that all of these species except the Pileated (which was not present) fed upon locusts or grasshoppers during the devastating incursions of these insects in Nebraska. The vegetable matter, of course, stands in inverse order. The greatest quantity of mineral matter (sand) is taken by the Flicker, somewhat less by the Redhead, very little by the Downy and Hairy, and none at all by the Yellow-bellied and Pileated.

The stomachs of all of the 7 species except the Redhead and Red-bellied contained the substance designated as 'cambium' in the accompanying list of vegetable food. This is the layer of mucilaginous material lying just inside of the bark of trees, and from which both bark and wood are formed. It is supposed by many to be the main object sought by woodpeckers. Except in the case of a single species the stomach examination does not bear out this view, since cambium, if present at all, was in such small quantities as to be of no practical importance. The Yellow-bellied Woodpecker, however, is evidently fond of this substance, for in the stomachs examined it formed 23 percent of the whole food of the year. It was found in 37 stomachs, most of which were taken in April and October. Of 18 stomachs collected in April, 16 contained cambium, and one of the remaining contained no vegetable food whatever. Moreover, as the true cambium is a soft and easily digested substance it is probable that what is usually found in the stomachs is only the outer and harder part, which therefore represents a much larger quantity. The extent of the injury done by destroying cambium must depend on the quantity taken from individual trees. It is well known that woodpeckers sometimes do serious harm by removing the outer bark from large areas on the trunks of fruit trees. The rings of punctures often seen around the trunks of apple trees are certainly the work of the Sapsucker, though sometimes attributed to the Downy and Hairy Woodpeckers. But the bird is not sufficiently numerous in most parts of the country to do much damage.

It is a difficult task to summarize the results of the investigations herein detailed, more especially if an attempt is made to decide as to the comparative merits or demerits of each particular species. The stomach examinations do not always corroborate the testimony received from observers, and many no doubt will be inclined to think they have seen more harm done by some members of this family of birds than is shown by the data here published. If birds are seen feeding repeatedly on a certain kind of food the inference is that they are particularly fond of it, but the truth may be that they are eating it because they can find nothing they like better, and that a collection of their stomachs from many localities would show only a small percentage of this particular food.

In reviewing the results of these investigations and comparing one species with another, without losing sight of the fact that comparative good is not necessarily positive good, it appears that of 7 species considered the Downy Woodpecker is the most beneficial. This is due in part to the great number of insects it eats and in part to the nature of its vegetable food, which is of little value to man. Three-fourths of its food consists of insects, and few of these are useful kinds. Of grain, it eats practically none. The greatest sin we can lay at its door is the dissemination of poison ivy.

The Hairy Woodpecker probably ranks next to the Downy in point of usefulness. It eats fewer ants, but a relatively larger percentage of beetles and caterpillars. Its grain-eating record is trifling; 2 stomachs taken in September and October contained corn. For fruit, it seeks the forests and swamps, where it finds wild cherries, grapes, and the berries of dogwood and Virginia creeper. It eats fewer seeds of the poison ivy and poison sumac than the Downy.

The Flicker eats a smaller percentage of insects than either the Downy or the Hairy Woodpecker, but if eating ants is to be considered a virtue, as we have endeavored to show, then surely this bird must be exalted, for three-fourths of all the insects it eats, comprising nearly half of its whole food, are ants. It is accused of eating corn; how little its stomach yields is shown on another page. Fruit constitutes about one-fourth of its whole fare, but the bird depends on nature and not on man to furnish the supply.

Judged by the results of the stomach examinations of the Downy and Hairy Woodpecker and Flicker it would be hard to find three other species of our common birds with fewer harmful qualities. Not one of the trio shows a questionable trait, and they should be protected and encouraged in every possible way. Fortunately, only one, the Flicker, is liable to destruction, and for this bird each farmer and landowner should pass a protective law of his own.

The Redhead makes the best showing of the seven species in the kinds of insects eaten. It consumes fewer ants and more beetles than any of the others, in this respect standing at the head, and it has a pronounced taste for beetles of very large size. Unfortunately, however, its

fondness for predaceous beetles must be reckoned against it. It also leads in the consumption of grasshoppers; these and beetles together forming 36 percent of its whole food. The stomachs yielded enough corn to show that it has a taste for that grain, though not enough to indicate that any material damage is done. It eats largely of wild fruit, and also partakes rather freely of cultivated varieties, showing some preference for the larger ones, such as apples. In certain localities, particularly in winter, it feeds extensively on beechnuts. No charge can be brought against it on the score of injuring trees by pecking.

The Red-bellied Woodpecker is more of a vegetarian than any of the others. In certain localities in Florida it does some damage to oranges, but the habit is not general. On the other hand, it eats quantities of ants and beetles.

The Yellow-bellied Woodpecker seems to show only one questionable trait, that of a fondness for the sap and inner bark of trees. Both field observations and the contents of the stomachs prove this charge against it, but it is not probable that forest trees are extensively injured, or that they ever will be, for aside from the fact that the bark of many trees would be unpalatable an immense number of birds would be required to do serious damage. But with fruit trees the case is different. Their number is limited, and there are no superfluous ones as in the forest. In localities where the bird is abundant considerable harm may be done to apple trees, which appear to be pleasing to its taste.

The Pileated Woodpecker is more exclusively a forest bird than any of the others, and its food consists of such elements as the woods afford, particularly the larvæ of wood-boring beetles, and wild fruits. The species is emphatically a conservator of the forests.

In describing the stomach contents of the different woodpeckers a quantity of material is classed under the term 'rubbish.' The great bulk of this stuff is rotten wood and bark, picked up in digging for insects in decayed timber, and apparently swallowed accidentally with the food. If the 6 woodpeckers which had eaten rotten wood are compared with respect to the quantity of this material contained in the stomachs it is found that the Hairy Woodpecker stands at the head with 8 percent, the Downy next with 5, the Flicker with 3, the Redhead and Yellow-bellied with 1 percent each, and the Pileated with only a trace. From this it appears that the Hairy Woodpecker is preeminently a *woodpecker*, while the Redhead and Yellow-belly do much less of this kind of work. The difference in habit is obvious to the most casual observer. The Redhead is ordinarily seen upon a fence post or telegraph pole hunting for insects that alight on these exposed surfaces, and watching for others that fly near enough to be captured in mid-air. Unlike other woodpeckers, he is seldom seen digging at a rotten branch except in spring, when he prepares a home for the family he intends to rear. The Yellow-bellied, as will be shown presently, does much wood (or bark) pecking, but of another kind.

The following tables show the food percentages of the stomachs examined:

Percentages of food of 7 species of woodpeckers.

Name of species.	No. of stomachs examined.	Percentage of stomach contents.			Percentage of different insects.						
		Animal.	Vegetable.	Mineral.	Hymenoptera (ants).	Coleoptera (beetles).	Lepidoptera (caterpillars).	Orthoptera (grasshoppers).	Hemiptera (bugs, plant lice).	Diptera (flies).	Spiders and myriapods.
Downy Woodpecker (*Dryobates pubescens*)	140	74	25	1	23	24	16	3	4	1	3
Hairy Woodpecker (*Dryobates villosus*)	82	68	31	1	17	24	21	Trace.	2	.....	4
Flicker (*Colaptes auratus*)	230	56	39	5	43	10	1	1	Trace.	Trace.	1
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	101	50	47	3	11	31	1	5	1	.....	1
Red-bellied Woodpecker (*Melanerpes carolinus*)	22	26	74	Trace.	11	10	4	Trace.	Trace.	.....	Trace.
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	81	50	50	.....	36	5	2	1	1	3	2
Pileated Woodpecker (*Ceophlœus pileatus*)	23	51	49	.....	30	15	2	Trace.	4	Trace.	Trace.

Relative proportions of larval and adult beetles (Coleoptera) in stomachs of 7 species of woodpeckers.

Name of species.	Number of stomachs examined.	Number containing adult Coleoptera.	Number containing larval Coleoptera.	Percentage of whole number.		Percentage of stomach contents.	
				Adult.	Larvæ.	Adult.	Larvæ.
Downy Woodpecker (*Dryobates pubescens*)	140	50	60	38	43	11	13
Hairy Woodpecker (*Dryobates villosus*)	82	27	46	33	56	6	18
Flicker (*Colaptes auratus*)	230	67	18	25	8	8	2
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	101	83	.....	82	.....	31	.....
Red-bellied Woodpecker (*Melanerpes carolinus*)	22	6	4	27	18	7	3
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	81	15	1	19	1	5	Trace.
Pileated Woodpecker (*Ceophlœus pileatus*)	23	4	12	17	52	2	1

DOWNY WOODPECKER.

(*Dryobates pubescens.*)

This little woodpecker is the smallest, not only of the 7 species under consideration, but of all those inhabiting the United States. He is also one of the most familiar, being no stranger to the shade trees about houses and parks, while his fondness for orchards is well known. He is so quiet and unobtrusive that the first notice one has of his presence may be a gentle tapping or scratching on the limb of a tree within two or three yards of one's head, where our diminutive friend

has discovered a decayed spot inhabited by wood-boring larvæ or a colony of ants.

One hundred and forty stomachs of the Downy Woodpecker have been examined. They were collected during every month in the year and in 21 States, the District of Columbia, Ontario, and New Brunswick. A few of the western subspecies (*Dryobates pubescens gairdneri*), from British Columbia, have been included. The stomachs contained 74 percent of insects, 25 percent of vegetable matter, and 1 percent of mineral matter or sand. The insects belong to the following orders: Ants (*Hymenoptera*), beetles (*Coleoptera*), bugs (*Hemiptera*), flies (*Diptera*), caterpillars (*Lepidoptera*), and grasshoppers (*Orthoptera*). Spiders and myriapods were also present. While all of these were eaten to some extent, they appear in widely different proportions. The ants constitute almost one-third of all the animal food, or about 23 per cent of the whole, indicating a very decided taste for this rather acid and highly flavored article of diet. Beetles stand a little higher in order of importance, amounting to about one-third of the entire insect food, or somewhat more than 24 percent of all. Many of these belong to the family of May beetles, a few were the predaceous ground beetles, but by far the greatest number were wood-boring larvæ, a fact showing that this little bird while securing his dinner is doing good work for the forest. One-fifth of the animal food, or 16 percent of the total, consists of caterpillars, many of which apparently are wood-boring species; others are kinds that live on stems and foliage. Among insects the most interesting are the bugs (*Hemiptera*), which are represented in the stomachs by several species, notably by plant lice (*Aphides*), which in several instances were found in considerable quantities, amounting to 4 percent of the whole food. From the minute size and very perishable nature of these insects it is evident that they must disappear from the stomach in a very short time, and it is fair to infer that many more were eaten than shown by the food remains. Spiders, including harvestmen or daddy longlegs, were eaten freely, and amounted to nearly one-tenth of thewhole. A few bits of snail shell were found in one stomach.

Eleven Downy Woodpeckers from Kansas collected in winter (December) deserve special notice. Eight of them had eaten the eggs of grasshoppers to an average extent of 10 percent of all their food. This, besides being in itself a good work, emphasizes the fact that this bird resorts to the ground for food in case of necessity.

Prof. Samuel Aughey examined 4 stomachs of the Downy Woodpecker in Nebraska, all of which contained grasshoppers.

The late Dr. Townend Glover, entomologist of the Department of Agriculture, states that the stomach of a Downy Woodpecker shot in February "was filled with black ants." He states further, "On one occasion a Downy Woodpecker was observed by myself making a number of small, rough-edged perforations in the bark of a young ash

tree, and upon examining the tree when the bird had flown it was found that wherever the bark had been injured the young larvæ of a wood-eating beetle had been snugly coiled underneath and had been destroyed by the bird."[1]

In the matter of vegetable diet, the taste of the Downy Woodpecker is varied, prompting him to eat a little of a good many things rather than a large quantity of any one. The following is a list of the vegetable substances that were identified:

Grain:
- Indeterminable.

Fruit:
- Dogwood berries (*Cornus florida*), (*C. alternifolia*), and (*C. asperifolia*).
- Virginia creeper berries (*Parthenocissus*[2] *quinquefolia*).
- June or service berries (*Amelanchier canadensis*).
- Strawberries (*Fragaria*).
- Pokeberries (*Phytolacca decandra*).
- Apples.
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus sp.?*).
- Mullein seeds (*Verbascum thapsus*).
- Hornbeam seeds (*Ostrya virginana*).
- Nut, unidentified.
- Flower petals and buds.
- Galls.
- Cambium.
- Seeds, unidentified.
- Rubbish.

Material believed to be fragments of grain was found in 2 stomachs but the quantity was so small that it may be dismissed without further comment. Fruit is by far the largest item of vegetable diet, forming one-tenth of the whole food. Strawberry seeds were found in only 1 stomach, apple pulp was supposed to be identified in 2, and the other varieties meutioned in the table were distributed in about the same proportion; so that no great economic interest can attach to this part of the birds' diet. The seeds and other things included under the head 'Miscellaneous' constitute about one-twelfth of the total food. Seeds of poison ivy were found in 20 stomachs and poison sumac in 1. These plants, far from being harmful to the birds, seem to form a very agreeable article of diet, and are eaten by many species. Unfortunately these seeds are protected by a hard, horny covering which successfully resists the action of the stomach, so that they pass through the alimentary canal uninjured. It is probable that we owe to birds, more than any other agency, the presence of these noxious plants beside fences, copses, and hedge rows. The remaining vegetable food, about 5 percent, was classed as rubbish, and will be discussed in connection with some of the other woodpeckers.

No beechnuts were found in any of the stomachs examined, but Dr. Merriam informs me that in northern New York they feed extensively on this nut, particularly in fall, winter, and early spring. On April 5,

[1] U. S. Agr. Rept. for 1865, 1866, p. 37–38.

[2] Commonly called *Ampelopsis*. See (List of Pteridophyta and Spermatophyta), prepared by a committee of the Botanical Club of the A. A. A. S., 1893–94, which has been followed in all questions of botanical nomenclature.

1878, Dr. Merriam "shot 4 Downy Woodpeckers all of whose gizzards were full of beechnuts and contained nothing else. The birds were often seen on moss-covered logs, and even on the ground, searching for the nuts exposed by the melting snow." Dr. Merriam states also that he has seen this woodpecker in the fall eat the red berries of the mountain ash.

HAIRY WOODPECKER.

(*Dryobates villosus.*)

This woodpecker is as common as the Downy in most parts of the United States, and to the ordinary eye can only be distinguished by its greater size, its color and markings being almost exactly the same.

FIG. 1.—Hairy Woodpecker.

The Hairy is a noiser bird, however, often making his presence known by loud calls and obtrusive behavior and by rapid flights from tree to tree. Like the Downy, he has been accused of depredations on fruit, but the stomachs examined do not show that cultivated varieties form

any considerable part of his fare. Beside the general resemblance between the two birds there is also a remarkable similarity in their food habits, as shown by the stomach contents; the greatest difference being that the Hairy eats a smaller percentage of insects than the Downy. Eighty-two stomachs have been examined, collected during every month in the year, except February; and coming from 19 States, the District of Columbia, Ontario, New Brunswick, and Nova Scotia; though most were from the northern United States. The proportion of different kinds of food is as follows: Animal, 68 percent; vegetable, 31 percent; mineral, 1 percent. The insect material was made up of ants, beetles, caterpillars, bugs, and grasshoppers. Spiders and myriapods also were present. An inspection of the percentages shows that ants are not so highly prized by the Hairy as by the Downy, since they constitute only about 17 percent of the whole food, or one-fourth of the insect portion. Beetles, both larval and adult, stand relatively higher than in the case of the Downy, comprising 24 percent of all food, or more than one-third of the insect matter. Caterpillars were eaten in greater quantities, both actually and relatively, amounting to 21 percent of the whole food, or more than one-third of all the insect material. Spiders are well represented, and aggregate nearly 6 per cent of the entire food. Among the miscellaneous insects were a few aphids or plant lice. Grasshoppers were found in only 1 stomach, but Professor Aughey found them in 4 out of 6 stomachs examined by him in Nebraska.

Mr. F. M. Webster states that he has seen a Hairy Woodpecker successfully peck a hole through the parchment-like covering of the cocoon of a Cecropia moth, devouring the contents. On examining more than 20 cocoons in a grove of boxelders he found only 2 uninjured.

The Hairy Woodpecker selects a somewhat larger variety of vegetable food than the Downy, though of the same general character. The following list of fruits and seeds found in the stomachs does not indicate that the bird visits orchards and gardens for fruit so much as swamps and thickets, where wild grapes, woodbine, and dogwood bound:

Grain:
- Corn.

Fruit:
- Dogwood berries (*Cornus florida* and *C. asperifolia*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- June or service berries (*Amelanchier canadensis*).
- Spice berries (*Benzoin benzoin*).
- Sourgum berries (*Nyssa aquatica*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries (*Prunus virginiana*).
- Wild grapes (*Vitis cordifolia*).

Fruit—Continued:
- Blackberries or raspberries (*Rubus*).
- Pokeberries (*Phytolacca decandra*).
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus glabra*).
- Barngrass seeds (*Chamæraphis. sp?*).
- Hazelnuts.
- Seeds unidentified.
- Cambium.
- Spruce foliage (*Picea*).
- Rubbish.

The only grain discovered was corn, which was found in 2 stomachs. In one case it was green corn in the milk, but this is hardly sufficient to prove the habit of eating corn. Fruit aggregates a little more than 11 percent of the food of the species, and is fairly distributed among all the items in the above list. Since blackberries are the only kind of cultivated fruit found in the stomachs, and since they grow wild in abundance, it is evident that the Hairy Woodpecker does not at present cause any great damage by his fruit-eating habits. The substances in the miscellaneous list form about 11 percent of the whole food, and are practically of the same character as in the case of the Downy. Poison ivy seeds were eaten by 7 birds, and poison sumac by only 1, so that not so many seeds of these undesirable shrubs are distributed by the Hairy as by the Downy. The weed seeds in the stomachs were few in number, but in Iowa both the Hairy and the Downy Woodpeckers feed largely on weed seeds in winter, stomachs taken then containing little else. Rubbish amounts to about one-twelfth of all their food, which is the largest percentage shown by any species.

Dr. Merriam informs me that in northern New York the Hairy Woodpecker, like the other woodpeckers of the Adirondack region, feeds largely on beechnuts. In late fall, winter, and early spring following good yields of beechnuts the nuts form the principal food of the woodpeckers.

FLICKER.

(*Colaptes auratus.*)

This bird, one of the largest and best known of our woodpeckers, is more migratory than either the Hairy or Downy, in winter being scarce or absent from its breeding range in the Northern States, where it is very abundant in summer and early fall. The Yellow-shafted Flicker is distributed throughout the United States east of the Rocky Mountains. In the West it is replaced by the Red-shafted Flicker, which may be considered the same so far as food habits are concerned. Under one or the other of its various titles of Flicker, Golden-winged Woodpecker, High-holder, Yellow-hammer, Pigeon Woodpecker, and Hairy-wicket, it is known to every farmer and schoolboy and, unfortunately, to certain so-called sportsmen also, for this is the one woodpecker that is often seen in city markets. In most places it is a much shyer bird than either of the preceding, and while it frequents the farm and approaches buildings freely it keeps more in the tops of the trees and does not allow so near an approach of its greatest enemy, man. This is particularly true in the northeastern part of the country, where large bags of Pigeon Woodpeckers are annually made among the wild cherry trees in which the birds feed. The Flickers soon learn whom they have to fear, and such knowledge seems to be hereditary. They are very prolific, rearing from six to ten young at a brood, and so keep reasonably abundant in most parts of the country. The Flicker is the most

terrestrial of all the woodpeckers, in spite of his high-perching and high-nesting proclivities, and may often be seen walking about in the grass like a meadow lark.

In the investigation of its food habits 230 stomachs were examined, taken in every month of the year, although January and February have but 1 each. They were collected in 22 States, the District of Columbia, and the Northwest Territory, and are fairly well distributed over the region east of the Rocky Mountains. They contained 56 per cent of animal matter, 39 percent of vegetable, and 5 percent of mineral. It will be seen that the quantity of animal or insect material is less than in either of the preceding species, and the mineral matter somewhat greater. The following orders of insects were represented:

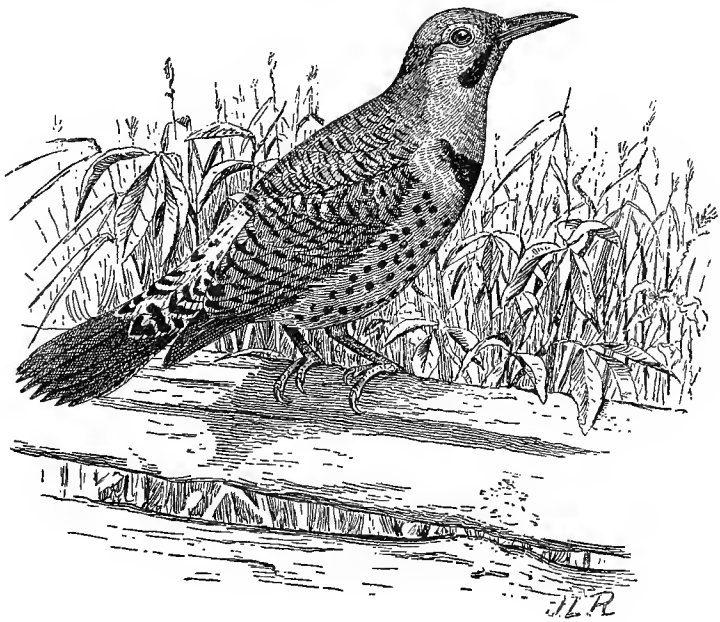


FIG. 2.—Flicker.

Ants (*Hymenoptera*), beetles (*Coleoptera*), bugs (*Hemiptera*), grasshoppers and crickets (*Orthoptera*), caterpillars (*Lepidoptera*), May flies (*Ephemerida*) and white ants (*Isoptera*). Spiders and myriapods also were present. An inspection of this insect matter shows the rather remarkable fact that more than three-fourths of it, or 43 percent of the whole food, consists of ants. If the mineral matter is thrown out as not being properly food, we find that more than 45 percent of the Flicker's food for the year consists of ants. Among the stomachs examined several contained nothing but ants. In two of these the actual number of ants present in each stomach exceeded 3,000. These were mostly small species that live in burrows in the earth, so that it is evident that when Flickers are seen upon the ground they are usually in search of

ants, although the other insects found in the stomachs account in part for this ground-feeding habit. Prof. Samuel Aughey examined 8 stomachs of Flickers in Dixon County, Nebr., in June, 1865. All of them contained grasshoppers, and the number in each stomach varied from 15 to 48.

As a large part of the food of the 7 woodpeckers studied consists of ants, the question may be asked whether the birds are doing good or harm by destroying them. There are so many different species of these insects, and they have such widely different habits, that it is difficult to make any assertion that will apply to all, but it is safe to say that many kinds are decidedly harmful, because they attend, protect, and help to spread plant, root, and bark lice of various species. These lice are among the worst enemies of plant life, and everything which tends to prevent their destruction is prejudicial to the interests of agriculture. Other species of ants destroy timber by burrowing in it; still others, in warmer climates, do much harm to fruit trees by cutting off the leaves and undermining the ground. Many species infest houses and other buildings. Apparently, then, birds do no harm in destroying ants, but on the contrary probably do much good by keeping within bounds these insect pests, whose greater abundance would be a serious injury to man. The Flicker takes the lead in this work, eating ants to the extent of nearly half of his whole food.

Next in importance to ants are beetles, which form about 10 percent of all the food, less than half the quantity eaten by the Hairy and Downy Woodpeckers. Among these were May beetles and their allies, and a few snapping beetles, but the greater number were Carabids or predaceous ground beetles. Most of these were in the adult form, but some larvæ of tiger beetles were identified. As these last live in burrows in the sand, and as Carabids live upon the ground, their presence in the stomachs again points to the terrestrial habits of the bird. The same is true of the grasshoppers and crickets. None of the other insects mentioned were eaten to any great extent, the whole aggregating only about 3 percent. Two stomachs contained each a single bedbug. Where they were obtained it is as difficult to surmise as it is to understand what motive could prompt the bird to swallow such an insect. Five stomachs contained each a few bits of snail shell.

In the matter of vegetable diet the Flicker has the most extensive list of any of the 7 woodpeckers, and many of the articles of food can only be obtained on the ground or among low bushes. Following is a list of all the vegetable substances identified in the Flicker's stomach:

Grain:
- Corn.
- Buckwheat.

Fruit:
- Dogwood berries (*Cornus florida* and *C. asperifolia*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- Hackberries (*Celtis occidentalis*).
- Black alder berries (*Ilex verticillata*).
- Sourgum berries (*Nyssa aquatica*).
- Cat or greenbrier berries (*Smilax glauca*).
- Blueberries (*Vaccinium* sp.).
- Huckleberries (*Gaylussacia* sp.).
- Pokeberries (*Phytolacca decandra*).
- June or service berries (*Amelanchier canadensis*).
- Spice berries (*Benzoin benzoin*).
- Elderberries (*Sambucus canadensis* and *S. pubens*).
- Mulberries (*Morus*).
- Wild grapes (*Vitis cordifolia*).
- Wild black cherries (*Prunus serotina*).
- Choke cherries (*Prunus virginiana*).
- Cultivated cherries.
- Blackberries (*Rubus*)
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Poison sumac seeds (*Rhus vernix*).
- Harmless sumac seeds (*Rhus copallina* and *R. glabra*).
- Waxberries or bayberries (*Myrica cerifera*).
- Juniper berries (*Juniperus virginiana*).
- Knotweed or smartweed (*Polygonum convolvulus, P. persicaria, P. lapathifolium*).
- Clover seed (*Trifolium repens*).
- Grass seed (*Phleum*).
- Pigweed seed (*Chenopodium*).
- Mullein seed (*Verbascum thapsus*).
- Ragweed (*Ambrosia*).
- Magnolia seed (*Magnolia grandiflora*).
- Acorns (*Quercus*).
- Seed unidentified.
- Cambium.
- Rubbish.

Of the two kinds of grain in the above list corn was identified in 5 stomachs, buckwheat in 1. One of the stomachs containing corn was taken in March and the bird had made a full meal of it, probably because he could get nothing else. Three of the others were collected in September, and the corn was evidently 'in the milk.' The fifth was taken in October, and is of a somewhat doubtful nature.

The Department of Agriculture has received a number of reports that implicate woodpeckers in damage done to crops. The only one of any consequence is from Dr. E. S. C. Foster, of Russell County, Kans., who states that the Red-headed and Golden-winged Woodpeckers damage corn in the roasting ear by tearing open the husks. He does not say for what purpose the husks are torn open, though some observers have declared that the object is to obtain the grub which sometimes infests the ear. The testimony furnished by the stomachs does not indicate that the Golden-wing has much to do with corn stealing, for it appears that out of 98 stomachs taken in September and October, the season of harvest, only 4 contained corn at all, and these in quantities ranging from 4 to 30 percent of the stomach contents. The buckwheat was eaten in September. The Flicker has a rich and varied list of fruit, embracing at least 20 different kinds, nearly all of which are wild.

The two items of grain and fruit together constitute about 25 per cent of the whole food, the grain, however, being of little consequence. With all this fruit eating, the Flicker trespassed upon man's preserves for cherries only, and these were found in only 1 stomach. Several

observers, however, have testified that some damage is done. T. J. Parrish, of Cooke County, Tex., states that the Yellow-hammers and small woodpeckers feed on peaches, plums, grapes, and cherries.

Miscellaneous vegetable substances aggregate a little more than 10 percent of the whole food of this bird, and like the fruit list, consist of a variety of elements. Poison ivy seeds were found in 20 stomachs, poison sumac in 5, and bayberries in 14. All these seeds are coated with a white substance resembling wax, and while the quantity is small compared with the size of the seeds, it is probably rich in nutritive properties, for the seeds are a favorite article of winter diet with many birds. A number of weed seeds were found, and if eaten in considerable quantities would be a great argument in the bird's favor, but unfortunately they occurred in only one or two stomachs each, and so may be considered as merely picked up experimentally in default of something better. It is possible that a series of stomachs taken in the winter months might show a larger percentage, as has been observed in the case of other species of birds, including at least 2 woodpeckers. The mineral element of the stomach contents is larger in the Flicker than any of the others, forming 5 percent of the whole, and consisting principally of fine sand. It was noticed that the greatest quantity was present in stomachs containing ants, showing that the sand was picked up accidentally in gathering the ants from their hillocks.

RED-HEADED WOODPECKER.

(*Melanerpes erythrocephalus.*)

The handsome Redhead inhabits suitable localities throughout the United States east of the Rocky Mountains, but is only casual in New England. He is a familiar bird on telegraph poles and fence posts, and seems to prefer these rather unpicturesque objects to other apparently more fruitful hunting grounds. He feeds largely on insects found upon these bare surfaces, but the vegetable matter in his stomach shows that he forages in other pastures also.

Fifty years ago Giraud stated that on Long Island the Red-headed Woodpecker arrives early in April, and during the spring "subsists chiefly on insects. In the summer it frequents the fruit trees, ripe cherries and pears seeming to be a favorite repast. In the fall it feeds on berries and acorns, the latter at this season forming a large portion of its food."[1]

In its fondness for mast it resembles its relative, the California Woodpecker, whose habit of storing acorns is one of its most conspicuous traits. In the northern part of its range, where the oak is replaced by the beech, the Redhead makes the beechnut its principal food. Dr. C. Hart

[1] Birds of Long Island, by J. P. Giraud, jr., 1844, p. 180.

Merriam has given much testimony under this head.[1] He states that in northern New York, where it is one of the commonest woodpeckers, it subsists almost exclusively on beechnuts during the fall and winter, even picking the green nuts before they are ripe and while the trees are still covered with leaves. He has shown that these woodpeckers invariably remain throughout the winter after good nut yields and migrate whenever the nut crop fails. He says: "Gray Squirrels, Red-headed Woodpeckers, and beechnuts were numerous during the winters

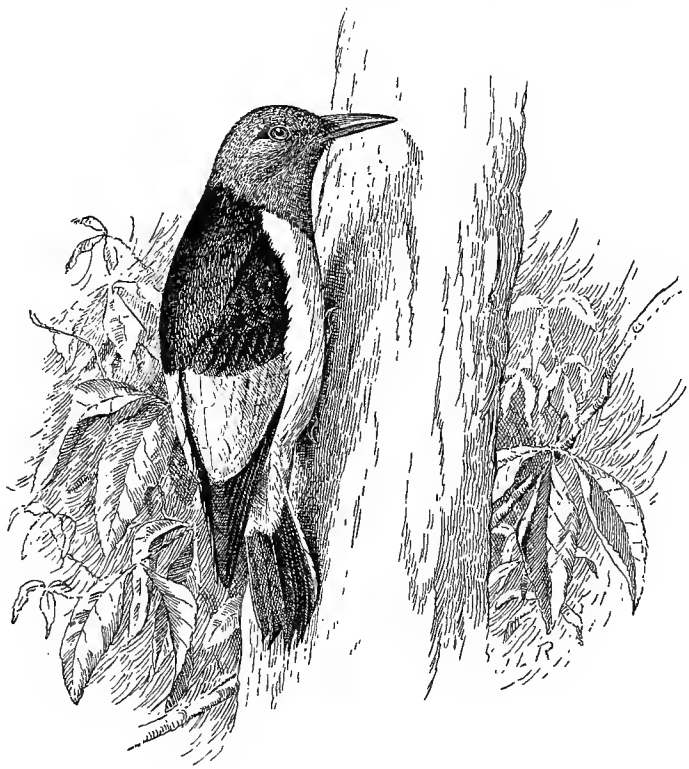


FIG. 3.—Red-headed Woodpecker.

of 1871–72, 1873–74, 1875–76, 1877–78, 1879–80, 1881–82, 1883–84, while during the alternate years the squirrels and nuts were scarce and the woodpeckers altogether absent;" and adds that in Lewis County, N. Y., "a good squirrel year is synonymous with a good year for *Melanerpes*, and vice versa." In early spring, following nut years, when the melting snow uncovers the ground, they feed on the beechnuts that were buried during winter. On April 5, 1878, at Locust Grove, N. Y., he shot 6 whose gizzards contained beechnuts and nothing else.

[1] Birds of Connecticut, 1877, p. 66; Bull. Nuttall Ornith. Club, Vol. III, 1878, p. 124; Mammals of the Adirondacks, 1884, p. 226.

In an interesting article in the Auk,[1] Mr. O. P. Hay says that in central Indiana during a good beechnut year, from the time the nuts began to ripen, the Redheads were almost constantly on the wing, passing from the beeches to some place of deposit. They hid the nuts in almost every conceivable situation. Many were placed in cavities in partly decayed trees; and the felling of an old beech was certain to provide a feast for the children. Large handfuls were taken from a single knot hole. They were often found under a patch of raised bark, and single nuts were driven into cracks in the bark. Others were thrust into cracks in gateposts; and a favorite place of deposit was behind long slivers on fence posts. In a few cases grains of corn were mixed with beechnuts. Nuts were often driven into cracks in the ends of railroad ties; and the birds were often seen on the roofs of houses pounding nuts into the crevices between the shingles. In several instances the space formed by a board springing away from a fence was nearly filled with nuts, and afterwards pieces of bark and wood were brought and driven over the nuts as if to hide them from poachers.

In summer Dr. Merriam has seen the Redheads "make frequent sallies into the air after passing insects, which were almost invariably secured." He has also seen them catch grasshoppers on the ground in a pasture.

Dr. A. K. Fisher saw several Red-headed Woodpeckers feeding on grasshoppers in the streets at Miles City, Mont., in the latter part of July, 1893. Several of the birds were seen capturing these insects near the hotel throughout the greater part of the forenoon. From a regular perch on top of a telegraph pole or cottonwood they descended on their prey, sometimes eating them on the ground, but more often returned to their former post to devour them.

The following interesting observation was made by Dr. G. S. Agersborg, of Vermillion, S. Dak.:[2]

> Last spring, in opening a good many birds of this species with the object of ascertaining their principal food, I found in their stomachs nothing but young grasshoppers. One of them, which had its headquarters near my house, was observed making frequent visits to an old oak post, and on examining it I found a large crack where the woodpecker had inserted about 100 grasshoppers of all sizes (for future use, as later observation proved), which were put in without killing them, but they were so firmly wedged in the crack that they in vain tried to get free. I told this to a couple of farmers, and found that they had also seen the same thing, and showed me posts which were used for the same purpose. Later in the season the woodpecker whose station was near my house, commenced to use his stores, and to-day (February 10), there are only a few shriveled-up grasshoppers left.

Mr. Charles Aldrich, of Webster City, Iowa, states that he saw a Red-headed Woodpecker catching grasshoppers on the prairie half a mile from timber. In Nebraska grasshoppers were found in 4 out of 6 stomachs examined by Prof. Samuel Aughey.

---

[1] Auk. Vol. IV, 1887, pp. 194,195.

[2] Bull. Nuttall Ornith. Club, Vol. III, 1878, p. 97.

Besides depredations upon fruit and grain, this woodpecker has been accused of destroying the eggs of other birds and even of killing the young; and from Florida comes a report that it enters poultry houses and sucks the eggs of domestic fowls. Mr. Charles Aldrich, of Webster City, Iowa, says that a Red-headed Woodpecker was seen to kill a duckling with a single blow on the head, and then to peck out and eat the brains.[1] In view of such testimony remains of eggs and young birds were carefully looked for in the stomachs examined, but pieces of eggshell were found in only 1 stomach of the Flicker and 2 of the Redhead.

A very unusual trait has been recorded by Dr. Howard Jones, of Circleville, Ohio. Dr. Jones says he has seen the Red-headed Woodpecker steal the eggs of eave swallows, and in cases where the necks of the nests were so long that the eggs were out of reach the woodpecker made a hole in the walls of the nest and so obtained the contents. In a colony of swallows containing 'dozens' of nests not a single brood of young was raised. One of the woodpeckers also began to prey upon hens' eggs, and was finally captured in the act of robbing the nest of a sitting hen.[2]

No traces of young birds or of any other vertebrates were discovered in the stomachs of any of the 7 species under consideration, except bones of a small frog which were found in the stomach of a Red-bellied Woodpecker (*Melanerpes carolinus*) from Florida.

The Redhead has been accused of doing considerable damage to fruit and grain, and both charges are fairly well sustained. In northern New York Dr. Merriam has seen it peck into apples on the tree, and has several times seen it feed on choke cherries (*Prunus virginiana*).

Mr. August Jahn, of Pope County, Ark., writes that it has damaged his corn to the amount of $10 or $15, and Dr. J. R. Mathers, of Upshur County, W. Va., says that the same species feeds on cherries, strawberries, raspberries, and blackberries, and that its depredations are sometimes serious. According to Mr. Witmer Stone, of Germantown, Pa., Red-headed Woodpeckers have been observed to strip a blackberry patch of all of its fruit. Mr. W. B. McDaniel, of Decatur County, Ga., also reports that the Sapsucker and Redhead eat grapes and cherries, the loss being sometimes considerable. These examples show the nature of the evidence contributed by eye-witnesses, the accuracy of whose observations there is no reason to doubt. That the stomach examinations do not reveal more damaging points against the species is not surprising, for a person seeing a bird eating his choice fruit, or in some other way inflicting damage, is more impressed by it than by the sight of a hundred of the same species quietly pursuing their ordinary vocations. Thus an occasional act is taken as a characteristic habit.

---

[1] Am. Nat., Vol. VI, No. 5, May, 1877, p. 308.

[2] Ornithologist and Oologist, Vol. VIII, No. 7, 1883, p. 56.

One hundred and one stomachs of the Redhead were examined from specimens collected throughout the year, although the bird is not generally abundant in the Northern States during the winter months. The specimens were taken in 20 States, the District of Columbia and Canada, and are fairly well distributed over the whole region east of the Rocky Mountains. The contents of the stomachs consisted of: Animal matter, 50 percent; vegetable matter, 47 percent; mineral matter, 3 percent. The animal and vegetable elements are nearly balanced, and the mineral element is larger than in any except the Flicker. The insects consist of ants, wasps, beetles, bugs, grasshoppers, crickets, moths, and caterpillars. Spiders and myriapods also were found. Ants amounted to about 11 percent of the whole food, which is the smallest showing of any of the 7 species under consideration, and is in harmony with the habits of the bird, which collects its food upon exposed surfaces where ants do not often occur. Beetle remains formed nearly one-third of all food, the highest record of any one of the 7 woodpeckers. The families represented were those of the common May beetle (*Lachnosterna*), which was found in several stomachs, the predaceous ground beetles, tiger beetles, weevils, and a few others. Among the May beetle family is a rather large, brilliant green beetle, known to entomologists as *Allorhina nitida*, but commonly called by the less dignified name of 'June bug.' It is very common during the early summer in the Middle and Southern States, but less so at the North. This insect was found in 11 stomachs, and 5 individuals were identified in a single stomach, which would seem an enormous meal for a bird of this size. Another large beetle eaten by this woodpecker is the fire-ground beetle (*Calosoma calidum*), a predaceous beetle of large size and vile odor. *Passalus cornutus*, one of the staghorns, a large insect, was also found, as well as a pair of mandibles belonging to *Prionus brevicornus*, one of the largest beetles in the United States. A preference for large beetles is one of the pronounced characteristics of this woodpecker. Weevils were found in 15 stomachs, and in several cases as many as 10 were present. Remains of Carabid beetles were found in 44 stomachs to an average amount of 24 percent of the contents of those that contained them, or 10 percent of all. The fact that 43 percent of all the birds taken had eaten these beetles, some of them to the extent of 16 individuals, shows a decided fondness for these insects, and taken with the fact that 5 stomachs contained Cicindelids or tiger beetles forms a rather strong indictment against the bird.

Grasshoppers and crickets formed 6 percent of the whole food, a larger percentage than in any of the other 7 species. The aggregate for all other insects is 4 percent, and the most important kinds are wasps and their allies. As this bird has often been seen capturing insects on the wing[1] it is probable that the wasps were taken in that way.

[1] See Merriam, Bull. Nuttall Ornith. Club, Vol. III, July, 1878, p. 126; also Forest and Stream, Vol. IX, January 17, 1878, p. 451.

The vegetable food of the Redhead presents considerable variety, and shows some points of difference from that of the other woodpeckers. The following is the list of substances identified:

Grain:
- Corn.

Fruit:
- Dogwood berries (*Cornus candidissima* and *C. florida*).
- Huckleberries (*Gaylussacia*).
- Strawberries (*Fragaria*).
- Blackberries or raspberries (*Rubus*).
- Mulberries (*Morus*).
- Elderberries (*Sambucus*).
- Wild black cherries (*Prunus serolina*).
- Choke cherries (*Prunus virginiana*).
- Cultivated cherries.
- Wild grapes (*Vitis cordifolia*).

Fruit—Continued.
- Apples.
- Pears.
- Unidentified.

Miscellaneous:
- Sumac seeds (*Rhus copallina* and *R. glabra*).
- Ragweed seeds (*Ambrosia*).
- Pigweed seeds (*Chenopodium*).
- Acorns (*Quercus*).
- Seeds unidentified.
- Galls.
- Flower anthers.
- Rubbish.

Corn was found in 17 stomachs, collected from May to September, inclusive, and amounted to more than 7 percent of all the food. While it seems to be eaten in any condition, that taken in the late summer was in the milk, and evidently picked from standing ears. This being the largest percentage of grain shown by any of the 7 species corroborates some of the testimony received, and indicates that the Redhead, if sufficiently abundant, might do considerable damage to the growing crop, particularly if other food was not at hand. While the fruit list is not so long as in the case of the Flicker, it includes more kinds that are, or may be, cultivated; and the quantity found in the stomachs, a little more than 33 percent of all the food, is greater than in any of the others. Strawberries were found in 1 stomach, blackberries or raspberries in 15, cultivated cherries in 2, apples in 4, and pears in 6. Fruit pulp was found in 33 stomachs, and it is almost certain that a large part of this was obtained from some of the larger cultivated varieties. Seeds were found in but few stomachs, and only a small number in each.

RED-BELLIED WOODPECKER.

(*Melanerpes carolinus.*)

The Red-bellied Woodpecker is a more southern species than any of the others treated in this bulletin. It is not known to breed north of the Carolinian fauna, and is abundant in Florida and the Gulf States. Curiously enough it sometimes migrates north of its breeding range to spend the winter.

Only 22 stomachs of this species have been obtained by the division. These were collected in 9 States, ranging from Florida to Michigan and from Maryland to Kansas, and in every month except April, June, and July. An examination of their stomachs shows: animal matter (insects)

26 percent and vegetable matter 74 percent. A small quantity of gravel was found in 7 stomachs, but was not reckoned as food. Ants were found in 14 stomachs, and amounted to 11 percent of the whole food. Adult beetles stand next in importance, aggregating 7 percent of all food, while larval beetles only reach 3 percent. Caterpillars had been taken by only 2 birds, but they had eaten so many that they amounted to 4 percent of the whole food. The remaining animal food is made up of small quantities of bugs (*Hemiptera*), crickets (*Orthoptera*), and spiders, with a few bones of a small tree frog found in 1 stomach taken in Florida.

Dr. B. H. Warren states that the stomachs of 3 Red-bellied Woodpeckers captured in winter in Chester and Delaware counties, Pa., contained black beetles, larvæ, fragments of acorns, and a few seeds of wild grapes. The stomachs of 8 adults from the St. Johns River, Florida, contained red seeds of 2 species of palmetto, but no insects. Two additional stomachs from the same locality contained palmetto berries, fragments of crickets (*Nemobius* and *Oracharis saltator*), a palmetto ant (*Camponotus escuriens*), and numerous joints of a myriapod, probably *Julus*.[1]

Dr. Townend Glover found in the stomach of a Red-bellied Woodpecker killed in December "pieces of acorns, seeds, and gravel, but no insects. Another, shot in December, contained wing-cases of *Buprestis*, and a species of wasp or *Polistes*, acorns, seeds, and no bark. A third, shot in May, was filled with seeds, pieces of bark, and insects, among which was an entire *Lachnosterna*, or May bug."[2]

The vegetable food of the Red-bellied Woodpecker contained in the 22 stomachs examined by the division consisted of the following seeds and fruits:

Grain:
- Corn.

Fruit:
- Mulberries (*Morus rubra*).
- Wild grapes (*Vitis cordifolia*).
- Virginia creeper (*Parthenocissus quinquefolia*).
- Elderberries (*Sambucus canadensis*).
- Rough-leaved cornel (*Cornus asperifolia*).

Fruit—Continued.
- Saw palmetto (*Sabal serrulata*).
- Holly (*Ilex opaca*).
- Wild sarsaparilla (*Aralia nudicaulis*).
- Bayberries (*Myrica cerifera*).
- Pine (*Pinus echinata*).
- Poison ivy (*Rhus radicans*).
- Ragweed (*Ambrosia* sp.).

Corn was found in only 2 stomachs. The other items were well distributed, and none of them appear to be specially preferred, unless it may be the poison ivy, which was found in 6 stomachs, and amounted to nearly 12 per cent of the whole food. Although 8 of the 22 birds were collected in Florida, no trace of the pulp of oranges was discovered, but that oranges are eaten by them is shown by the following interesting notes.

[1] Birds of Pennsylvania 2d ed., 1890, pp. 174, 175.
[2] U. S. Agric. Rept. for 1865, 1866, p. 38.

Dr. B. H. Warren states that in Florida the Red-bellied Woodpecker is commonly known as 'Orange Sapsucker' and 'Orange Borer.' Dr. Warren collected 26 of these woodpeckers in an orange grove near Volusia and found that 11 of them contained orange pulp. Three contained nothing else; the others had eaten also insects and berries.

Corroborating Dr. Warren's account, Mr. William Brewster states that at Enterprise, Fla., in February, 1889, he saw a Red-bellied Woodpecker eating the pulp of a sweet orange. Mr. Brewster states that the woodpecker attacked the orange on the ground, pecking at it in a slow and deliberate way for several minutes. On examining the orange it was found to be decayed on one side. "In the sound portion were three holes, each nearly as large as a silver dollar, with narrow strips of peel between them. The pulp had been eaten out quite to the middle of the fruit. Small pieces of rind were thickly strewn about the spot." Upon searching closely he discovered several other oranges that had been attacked in a similiar manner. All were partially decayed and were lying on the ground. He was unable to find any on the trees which showed any marks of the woodpecker's bill.[1]

Mr. Benjamin Mortimer, writing of the same bird at Sanford, Fla., says:

> During February and March, 1889, while gathering fruit or pruning orange trees, I frequently found oranges that had been riddled by this woodpecker and repeatedly saw the bird at work. I never observed it feeding upon fallen oranges. It helped itself freely to sound fruit that still hung on the trees, and in some instances I have found ten or twelve oranges on one tree that had been tapped by it. Where an orange accidentally rested on a branch in such a way as to make the flower end accessible from above or from a horizontal direction the woodpecker chose that spot, as through it he could reach into all the sections of the fruit, and when this was the case there was but one hole in the orange. But usually there were many holes around it. It appeared that after having once commenced on an orange, the woodpecker returned to the same one repeatedly until he had completely consumed the pulp, and then he usually attacked another very near to it. Thus I have found certain clusters in which every orange had been bored, while all the others on the tree were untouched. An old orange grower told me that the "Sapsuckers," as he called them, never touch any but very ripe oranges, and are troublesome only to such growers as reserved their crops for the late market. He also said that it is only within a very few years that they have shown a taste for the fruit; and I myself observed that, although Red-bellies were very common in the neighborhood, only an individual, or perhaps a pair, visited any one grove.[2]

[1] The Auk, Vol. VI, 1889, pp. 337–338.

[2] The Auk, Vol. VII, 1890, p. 340.

YELLOW-BELLIED WOODPECKER OR SAPSUCKER.

(*Sphyrapicus varius.*)

This species is probably the most migratory of all our woodpeckers, breeding only in the most northerly parts of the United States, and in some of the mountains farther south. In the fall it ranges southward, spending the winter in most of the Eastern States. It is less generally distributed than some of the other woodpeckers, being quite unknown in some sections and very abundant in others. For instance, Dr. C. Hart Merriam states that in the Adirondack region during migration it

FIG. 4.—Yellow-bellied Woodpecker or Sapsucker.

outnumbers all other species of the family together, and throughout the summer is second in numbers only to the Hairy Woodpecker; and at Mount Chocorua, New Hampshire, Mr. Frank Bolles found it the most abundant species. In Minnesota also it is very common. On the other hand, near my home in Massachusetts only two or three were observed each year; and during a residence of eight years in Iowa it was noted only three or four times.

It is to this species that the term 'Sapsucker' is most often and most justly applied, for it drills holes in the bark of certain trees and drinks the sap. It feeds also on cambium, insects, and wild fruits and berries.

In writing of the habits of these woodpeckers in northern New York in 1878, Dr. Merriam states:

They really do considerable mischief by drilling holes in the bark of apple, thornapple, and mountain ash trees in such a way as to form girdles of punctures, sometimes 2 feet or more in breadth (up and down), about the trunks and branches. * * * The holes, which are sometimes merely single punctures, and sometimes squarish spaces (multiple punctures) nearly half an inch across, are placed so near together that not unfrequently they cover more of the tree than the remaining bark. Hence, more than half of the bark is sometimes removed from the girdled portions, and the balance often dries up and comes off. Therefore it is not surprising that trees which have been extensively girdled generally die, and mountain ash are much more prone to do so than either apple or thornapple trees, due, very likely, to their more slender stems. The motive which induces this species to operate thus upon young and healthy trees is, I think, but partly understood. It is unquestionably true that they feed, to a certain extent, both upon the inner bark and the fresh sap from these trees, but that the procurement of these two elements of sustenance, gratifying as they doubtless are, is their chief aim in making the punctures I am inclined to dispute. As the sap exudes from the newly-made punctures, thousands of flies, yellow jackets, and other insects congregate about the place, till the hum of their wings suggests a swarm of bees. If, now, the tree be watched, the woodpecker will soon be seen to return and alight over the part of the girdle which he has most recently punctured. Here he remains, with motionless body, and feasts upon the choicest species from the host of insects within easy reach. * * * In making each girdle they work around the trunk, and from below upwards, but they may begin a new girdle below an old one. They make but few holes each day, and after completing two or three remain over the spot for some little time, and as the clear fresh sap exudes and trickles down the bark they place their bill against the dependent drop and suck it in with evident relish—a habit which has doubtless given rise to the more appropriate than elegant term Sapsucker, by which they are commonly known in some parts of the country. I have several times watched this performance at a distance of less than 10 feet, and all the details of the process were distinctly seen, the bird looking at me, meanwhile, 'out of the corner of his eye.' When his thirst is satisfied he silently disappears, and as silently returns again, after a few hours, to feast upon the insects that have been attracted to the spot by the escaping sap. This bird, then, by a few strokes of its bill, is enabled to secure both food (animal and vegetable) and drink in abundance for an entire day; and a single tree, favorably situated, may suffice for a whole season.[1]

The late Frank Bolles has published some interesting detailed observations respecting the food habits of the Sapsucker. His conclusions are:

That the Yellow-bellied Woodpecker is in the habit for successive years of drilling the canoe birch, red maple, red oak, white ash, and probably other trees, for the purpose of taking from them the elaborated sap, and in some cases parts of the cambium layer; that the birds consume the sap in large quantities for its own sake and not for insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird, but whose capture does not occupy its time to any-

[1] Bull. Nuttall Ornith. Club, Vol. IV, January, 1879, pp. 3–5.

thing like the extent to which sap drinking occupies it; * * * that the forest trees attacked by them generally die, possibly in the second or third year of use; that the total damage done by them is too insignificant to justify their persecution in well-wooded regions.[1]

Mr. Bolles shot 8 Sapsuckers in July and August, 1890. Their stomachs "were well filled with insects." Some of these were examined by Mr. Samuel H. Scudder, who states:

The insects in the different stomachs are in all cases almost exclusively composed of the harder chitinous parts of ants. In a cursory examination I find little else, though one or two beetles are represented, and No. 4 must have swallowed an entire wasp of the largest size, his head and wings attesting thereto.[2]

In a subsequent article Mr. Bolles gives the result of an attempt to keep several young Sapsuckers alive on a diet of dilute maple sirup. Unfortunately for the experiment, the birds obtained and greedily devoured numerous insects attracted to the cage by the sirup. How many of the insects were eaten was not known, but all of the birds died within four months. Examination of their bodies showed fatty degeneration of the liver—a condition said to be usual in cases of starvation. Mr. Bolles states:

The most probable cause of this enlargement of the liver, which seems to have been the reason for the death of the 3 Sapsuckers, was an undue proportion of sugar in their diet. In a wild state they would have eaten insects every day and kept their stomachs well filled with the chitinous parts of acid insects. Under restraint they secured fewer and fewer insects, until, during the last few weeks of their lives, they had practically no solid food of any kind.[3]

Mr. Bolles has thus proved by experiment that concentrated sap (saturated with sugar) is not sufficient to sustain life, even with the addition of a small percentage of insects. The logical inference is that sap, while liked by the birds and consumed in large quantities, holds a subordinate place as an article of food.

The Yellow-bellied Woodpecker is represented in the collection by 81 stomachs, distributed rather irregularly through the year. None were taken in February, March, or November, and only a few in January, June, and December; the great bulk were collected in April, August, September, and October. They were obtained from 15 States, the District of Columbia, and Nova Scotia. All were from the Northern States, except a few from North Carolina, Virginia, and the District of Columbia. Unlike any of the preceding species the vegetable element of the food here exactly equals the animal part. The insect matter was made up of ants, wasps, beetles, flies, bugs, grasshoppers, crickets, and mayflies. Some spiders also were present. Of the whole food, 36 percent consisted of ants, a higher percentage than in any other woodpecker except the Flicker. Beetles amounted to 5 percent, and do not appear to be a favorite food. Flies (*Diptera*) in various forms were

[1] The Auk, Vol. VIII, July, 1891, p. 270.
[2] The Auk, Vol. VIII, July, 1891, p. 269.
[3] The Auk, Vol. IX, April, 1892, p. 119.

eaten in larger numbers than by any of the others. Among them were several long-legged crane flies (*Tipulids*). Spiders were eaten to a small extent only, and most of these were phalangers or 'daddy-longlegs,' which, taken with the crane flies, would indicate a slight preference for long-legged prey. Bugs, wasps, caterpillars, crickets, and mayflies collectively amount to about 6 percent, no one of them reaching any very important figure. Prof. Samuel Aughey examined 5 stomachs of the Yellow-bellied Woodpecker in Nebraska, all of which contained grasshoppers. The number in each stomach varied from 15 to 33.

Mr. William Brewster states that at Umbagog Lake, Maine, "After the young have hatched, the habits of the Yellow-bellied Woodpecker change. From an humble delver after worms and larvæ, it rises to the proud independence of a flycatcher, taking its prey on wing as unerringly as the best marksman of them all. From its perch on the spire of some tall stub it makes a succession of rapid sorties after its abundant victims, and then flies off to its nest with bill and mouth crammed full of insects, principally large Diptera."[1]

The vegetable food of the Sapsucker is varied. The following fruits and berries were found in the stomachs:

Fruit:
- Dogwood berries (*Cornus florida*).
- Black alder berries (*Ilex verticillata*).
- Virginia creeper berries (*Parthenocissus quinquefolia*).
- Wild black cherries (*Prunus serotina*).
- Blackberries or raspberries (*Rubus*).
- Unidentified.

Miscellaneous:
- Poison ivy seeds (*Rhus radicans*).
- Mullein seeds (*Verbascum thapsus*).
- Juniper berries (*Juniperus virginiana*).
- Buds.
- Seeds unidentified.
- Cambium.
- Rubbish.

The quantity of fruit found in the stomachs formed 26 percent of the entire food, but the only kinds identified that might possibly be cultivated were blackberries and raspberries, and these were in only 2 stomachs. Unidentifiable fruit pulp was found in 12 stomachs. Miscellaneous seeds to the amount of 5 percent complete the list of substances eaten by this species. Poison ivy seeds were found in only 1 stomach, and most of the other things were distributed in about the same proportion.

Dr. Merriam informs me that in the fall in northern New York the Sapsuckers feed on ripening beechnuts, the small branches bending low with the weight of the birds while picking the tender nuts.

[1] Bull. Nuttall Ornith. Club, Vol. I, 1876, No. 3, p. 69.

GREAT PILEATED WOODPECKER.

(*Ceophlœus pileatus.*)

Excepting the Ivory Bill this is the largest woodpecker in the United States, where it inhabits most of the heavily wooded districts. It is shy and retiring, seldom appearing outside of the forests, and difficult to approach even in its favorite haunts. Its large size, loud voice, and habit of hammering upon dead trees render it conspicuous. Its strength is marvelous, and one unacquainted with it can scarcely credit a bird with such power of destruction as is sometimes shown by a stump or dead trunk on which it has operated for ants or boring larvæ.

Only 23 stomachs of the Pileated Woodpecker have been obtained; all taken in the months of October, November, December, and January, and collected from 6 States, the District of Columbia, and Canada (including New Brunswick). Fifty-one percent of the contents of these stomachs consisted of animal matter or insects; 49 percent of vegetable matter. The insects were principally ants and beetles, with a few of some other orders. The ants were mostly of the larger species that live in decaying wood. A large proportion of the beetles were in the larval form, and all were of the wood-boring species. There were also a few caterpillars, also wood-borers, a few plant lice, several cockroaches of the species that live under the bark of dead trees, a few white ants and a few flies, with one spider.

The gizzard of a Pileated Woodpecker shot by Dr. Merriam in the Adirondacks, April 25, 1882, contained hundreds of large ants and no other food. Six stomachs, collected by Dr. B. H. Warren on the St. Johns River in Florida, contained numerous palmetto ants (*Campanotus escuriens*), and remains of other ants, several larvæ of a Prionid beetle (*Orthosoma brunnea*), numerous builder ants (*Cremastogaster lineolata*), one larva of *Xylotrechus*, and one pupa of the white ant (*Termes*). The insects were determined under Prof. C. V. Riley.[1]

Seeds and berries of the following plants were found in the stomachs examined by the division:

Sourgum (*Nyssa aquatica*).
Flowering dogwood (*Cornus florida*).
Black haw (*Viburnum prunifolium*).
Cassena (*Ilex cassine*).
Hackberry (*Celtis occidentalis*).
Persimmon (*Diospyros virginiana*).
Wild grapes (*Vitis cordifolia*).
Virginia creeper (*Parthenocissus quinquefolia*).
Greenbrier (*Smilax rotundifolia* and *S. glauca*).
Sumac (*Rhus copallina*).
Poison sumac (*Rhus vernix*).
Poison ivy (*Rhus radicans*).

[1] Birds of Pennsylvania, 2d ed., 1890, p. 177.

In addition to the 7 species of woodpeckers whose food has been already discussed, 57 stomachs have been examined, belonging to 12 species and subspecies, mostly from the southern and western parts of the United States and British Columbia, as follows:

	Stomachs.
Nuttall's Woodpecker (*Dryobates nuttalii*)	7
Red-cockaded Woodpecker (*Dryobates borealis*)	12
Baird's Woodpecker (*Dryobates scalaris bairdi*)	3
Gilded Flicker (*Colaptes chrysoides*)	3
Red-shafted Flicker (*Colaptes cafer*)	11
Northwestern Flicker (*Colaptes cafer saturatior*)	5
California Woodpecker (*Melanerpes formicivorus bairdi*)	1
Lewis's Woodpecker (*Melanerpes torquatus*)	3
Gila Woodpecker (*Melanerpes uropygialis*)	1
Red-breasted Sapsucker (*Sphyrapicus ruber*)	1
Arctic Three-toed Woodpecker (*Picoides arcticus*)	7
Alpine Three-toed Woodpecker (*Picoides americanus dorsalis*)	3

With such a small number of stomachs it is hardly worth while to discuss the food of each species. The Three-toed Woodpeckers (*Picoides*), however, deserve passing notice, since their food contains a larger percentage of wood-boring larvæ than any other woodpecker examined. As the food of the two species is practically the same they may be considered together. The contents of the 10 stomachs consists of: animal matter, 83 percent; vegetable matter, 17 percent. It is a question whether this should not all be considered as animal, for the vegetable portion consisted almost entirely of rotten wood and similar rubbish, probably taken accidentally, and is not in any proper sense food, the exception being in one case where a little cambium had been eaten by one individual of the Arctic Three-toed Woodpecker (*Picoides arcticus*) and a few skins of some small fruit by one Alpine Three-toed Woodpecker (*P. americanus dorsalis*). The animal food consisted of 63 per cent of wood-boring Coleopterous larvæ (beetles), 11 percent of Lepidopterous larvæ (caterpillars), probably also wood-borers, and 9 per cent of adult beetles, ants, and other Hymenopterous insects.

THE TONGUES OF WOODPECKERS.[1]

RELATION OF THE FORM OF THE TONGUE TO THE CHARACTER OF THE FOOD.

By FREDERIC A. LUCAS,

Curator, Department of Comparative Anatomy, United States National Museum.

Whether the tongues of birds are of value in classification, or whether the modifications of the tongue, at least the external modifications, are due to adaptation to the character of the food or the manner in which food is manipulated, is a question of much interest. Unfortunately the food and feeding habits of birds are so little known that in many cases the adaptive characters of the tongue are not recognized, since without a knowledge of the one it is difficult or impossible to explain the peculiarities of the other.

The results of the preliminary investigation of the food of North American woodpeckers, made by the Division of Ornithology and Mammalogy of the Department of Agriculture, suggested that this group would be a most excellent one to study, and the tongues of all available species have been examined.

The woodpeckers are structurally a well-marked, compact group, and any variation in the structure of a given part, if shown to be directly correlated with some peculiarity of habit, would be a good indication that the one was dependent on the other. A comparison of the structure and modifications of the tongue with the results obtained from the examination of a large series of stomachs will, it is thought, show that just such a correlation does exist between the two, and that the form of the tongue varies surprisingly according to the nature of the food.

It is of course always necessary to bear in mind that the food of a bird necessarily varies with the season—a fact well shown by the group under consideration—and consequently that the peculiarity of the tongue may be related to some special kind of food, or particular method of obtaining it, pursued during a portion of the year only. A

[1] Published by permission of Dr. G. Brown Goode, Director United States National Museum.

particular kind of food which could be best obtained by some special adaptive feature would naturally have more influence as a modifying agent, even if indulged in for only a short time, than a general diet for a long period, since the one would be positive in its effects, the other negative.

As the hyoid bone is the framework on which the tongue is built, it will be well to note some of its characteristic features in the woodpeckers before proceeding to the modifications of the tongue itself. The hyoid is so constructed as to combine the two characters of length and strength that are needed for extensile purposes. The front of the hyoid is formed by the short, fused cerato-hyals, although a groove, or in some cases a perforation, indicates the double origin of this bone. The basi-hyal is usually very long and very slender and the cerato-branchials abut upon its posterior end, the basi-branchial being absent, nor have any indications of this bone been found even in very young specimens. The cerato-branchials and epi-branchials are variable, especially the latter, which, as in the Sapsucker (*Sphyrapicus*), may be no longer than in many Passeres, or, as in the Flickers (*Colaptes*), reach the maximum length among birds. The epi-branchials curve up over the back of the skull, meet on its summit, and continue on toward the forehead. In other long-tongued birds, as in the humming bird (*Trochilus*), for example, the apposed bones reach to the base of the bill, but in the longest-tongued woodpeckers they turn to the right, pass through the right narial opening, dipping under the nostril, and thence continue quite to the tip of the bill, so that in these species the extreme possible length of tongue is reached unless some other device is resorted to.[1] The cerato-branchials lie side by side when the tongue is protruded, and even when it is withdrawn they are posteriorly but little separated. The general character of the hyoid is constant in all species examined, but, as just stated, the proportions of its component parts vary, the extremes being represented by the Sapsucker (*Sphyrapicus*) and Flicker (*Colaptes*), both of which are figured (Pl. III, figs. 1, 3).

Externally the tongue consists at the tip of a horny portion more or less barbed along the edges; this is followed by a section covered with tough skin bearing on the upper surface a long patch of minute points, while the basal portion is clothed with smooth, elastic skin, which is more or less wrinkled tranversely when the tongue is retracted. The skin covering the base of the tongue is reflected, forming a sort of sheath, into which the basal part of the tongue is withdrawn when at rest. The shape of the patch of minute points, as well as the number and character of the points themselves, seems to vary in different species,

[1] It would appear that a method is already in use by which the length of the tongue can be greatly increased, and this is the curling of the free ends of the epi-branchials into a spiral. Although I have never met with a specimen in which the hyoid was so arranged, both Dr. Bryant and Mr. Wm. Palmer have recorded specimens in which the hyoid encircled the eye. Dr. Bryant's paper, entitled "Remarks on *Sphyrapicus varius*, Linn.," appeared in Proc. Best. Soc. Nat. Hist., Vol. X, 1864–'66, pp. 91–93.

and, although these points are so small as to appear like mere granulations, they are seen under the microscope to have a perfectly definite form and to be directed backward (Pl. III, figs 8, 9.) They are smallest toward the front of the patch, and increase in size from thence backward.

The anterior, horny portion of the tongue is also subject to great variation. In most species it is armed on either side with a number of sharp, backwardly-directed spines, but these may vary in number from two or three in the Flicker (*Colaptes*, Pl. II, fig. 10), up to thirty or forty in the Redhead (*Melanerpes*, Pl. II, fig. 2). One specimen of Flicker, labeled *Colaptes hybridus*, Pl. I, fig. 1), had the tip of the tongue wholly unarmed; but this may have been an individual peculiarity, and if so, would be interesting as showing the retention in the adult of the condition found in the young. In the Sapsucker (*Sphyrapicus*) the tongue bears no spines, but two series of stiff hairs, the lower set directed outward, the upper series backward. Of course, strictly speaking, these hairs are simply very slender spines, and in the California Woodpecker (*Melanerpes formicivorous bairdi*, Pl. II, fig. 1) we find an almost intermediate stage, the spines being quite fine, and the sides of the tongue, as in a few other species, furnished with a few short hairs lying below the spines and directed outward and forward.

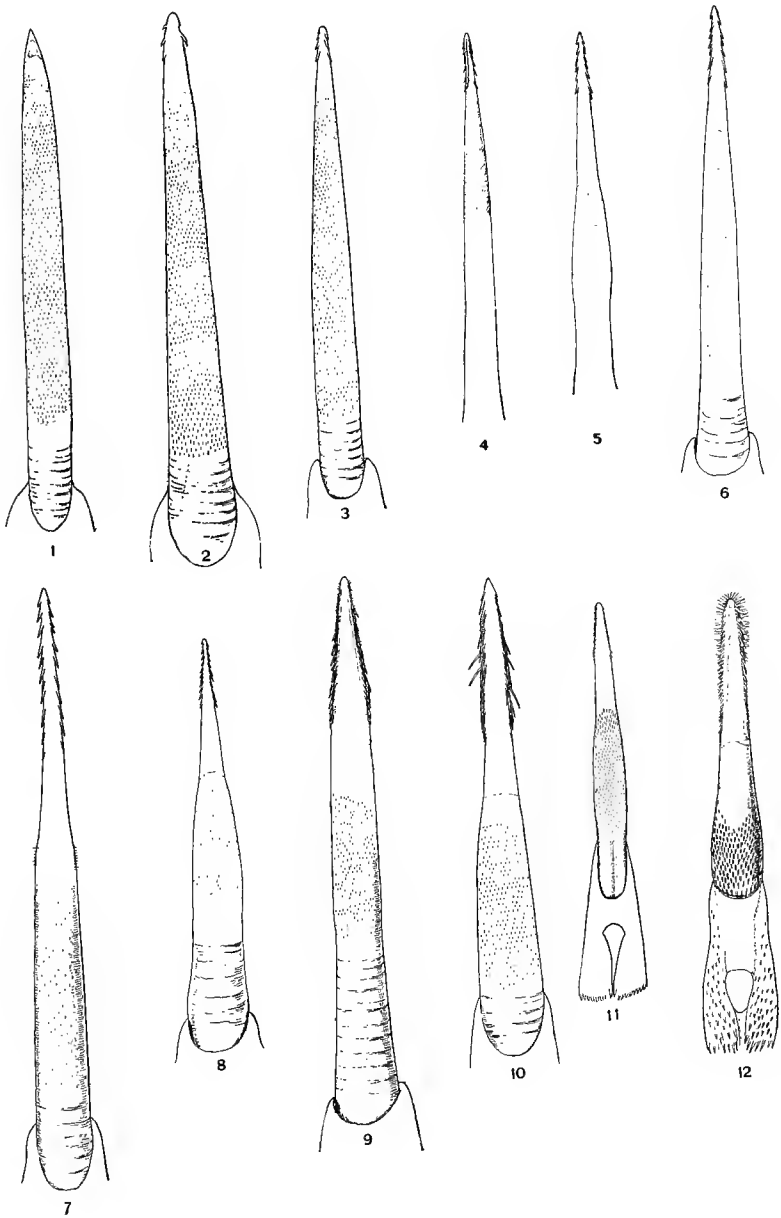
In very young woodpeckers the tongue is unarmed at the point, bearing neither hairs nor spines, although the patch of minute points on the upper surface is present from the first. Later on, as indicated by a fully-fledged nestling of the Downy Woodpecker (*Dryobates pubescens*, Pl. III, fig. 6), a species whose tongue, when adult, is armed with sharp barbs, the spines are represented by short, fine, reflexed hairs, like the upper series of the Sapsucker (*Sphyrapicus varius*). Thus it would seem that the lateral spines are acquired after the bird has commenced to fly, and that they must be developed very rapidly, although specimens showing the various stages in their acquisition are lacking. The growth of the hyoid must be correspondingly rapid, for in the nestling alluded to the ends of the epi-branchials reached only to the center of the skull, although the Downy is a long-tongued bird whose hyoid runs beneath the nostril into the bill. This rapid growth has been observed in the hyoid of humming birds, in which the growth of the bill is also very rapid after hatching, and it would appear that great changes take place in the tongue and beak about the time the young bird ceases to be fed and begins to feed itself.

If woodpeckers were to be classified by their tongues we would start with forms like Delattre's Woodpecker (*Ceophlœus scapularis*, Pl. II, fig. 11), and Flicker (*Colaptes auratus* or *C. chrysoides*, Pl. II, fig. 10), in which the tongue is armed with two or three points on each side; pass through the Pileated Woodpecker (*Ceophlœus pileatus*, Pl. II, fig. 9), into the White-headed Woodpecker (*Xenopicus albolarvatus*, Pl. II, fig. 8), and Downy Woodpecker (*Dryobates pubescens*, Pl. II, fig. 4),

Plate I.

Tongues of North American Woodpeckers (all viewed from above and enlarged $2\frac{1}{4}$ diameters).

Fig. 1. Hybrid Flicker (*Colaptes*). Fort Pierre, S. Dak.
2. Delattre's Woodpecker (*Ceophlœus scapularis*). Tabasco, Mexico.
3. Gilded Flicker (*Colaptes chrysoides*). San Jose del Cabo, Lower California.
4. Downy Woodpecker (*Dryobates pubescens*). Washington, D. C.
5. White-headed Woodpecker (*Xenopicus albolarvatus*). Clarks Fork, Columbia River, Washington.
6. Hairy Woodpecker (*Dryobates villosus*).
7. Gila Woodpecker (*Melanerpes uropygialis*). Fort Huachuca, Ariz.
8. Three-toed Woodpecker (*Picoides arcticus*). Illinois.
9. Red-headed Woodpecker (*Melanerpes erythrocephalus*). Northern Illinois.
10. California Woodpecker (*Melanerpes formicivorous bairdi*). Stockton, Cal.
11. Ladder-back Woodpecker (*Dryobates scalaris*). Matamoras, Mexico.
12. Red-naped Sapsucker (*Sphyrapicus varius nuchalis*). Fort Wingate, N. Mex.

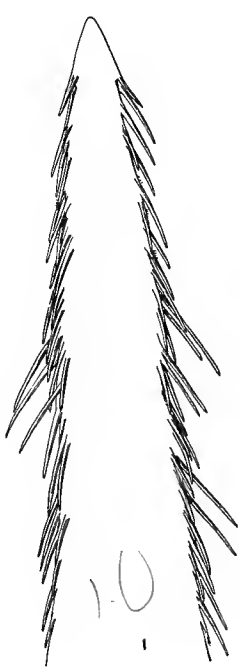


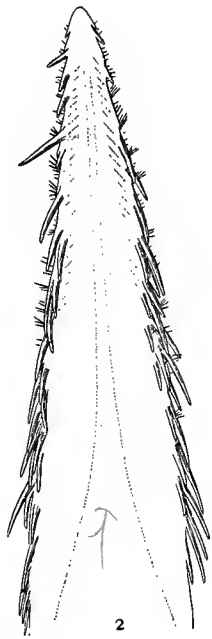
TONGUES OF WOODPECKERS.

PLATE II.

Tips of tongues of North American Woodpeckers (all save 4 viewed from above and enlarged $9\frac{1}{3}$ diameters).

Fig. 1. California Woodpecker (*Melanerpes formicivorous bairdi*). Stockton, Cal.
2. Red-headed Woodpecker (*Melanerpes erythrocephalus*). Northern Illinois.
3. Ladder-back Woodpecker (*Dryobates scalaris*). Matamoras, Mexico.
4. Downy Woodpecker (*Dryobates pubescens*). Washington, D. C.
5. Three-toed Woodpecker (*Picoides arcticus*). Illinois.
6. Gila Woodpecker (*Melanerpes uropygialis*). Fort Huachuca, Ariz.
6*a*. Another specimen showing variation due to wear of tongue. San Jose del Cabo, Lower California.
7. Hairy Woodpecker (*Dryobates villosus*).
8. White-headed Woodpecker (*Xenopicus albolarvatus*). Clarks Fork, Columbia River, Washington.
9. Pileated Woodpecker (*Ceophlœus pileatus*). Louisiana.
10. Gilded Flicker (*Colaptes chrysoides*). San Jose del Cabo, Lower California.
11. Delattre's Woodpecker (*Ceophlœus scapularis*). Tabasco, Mexico.

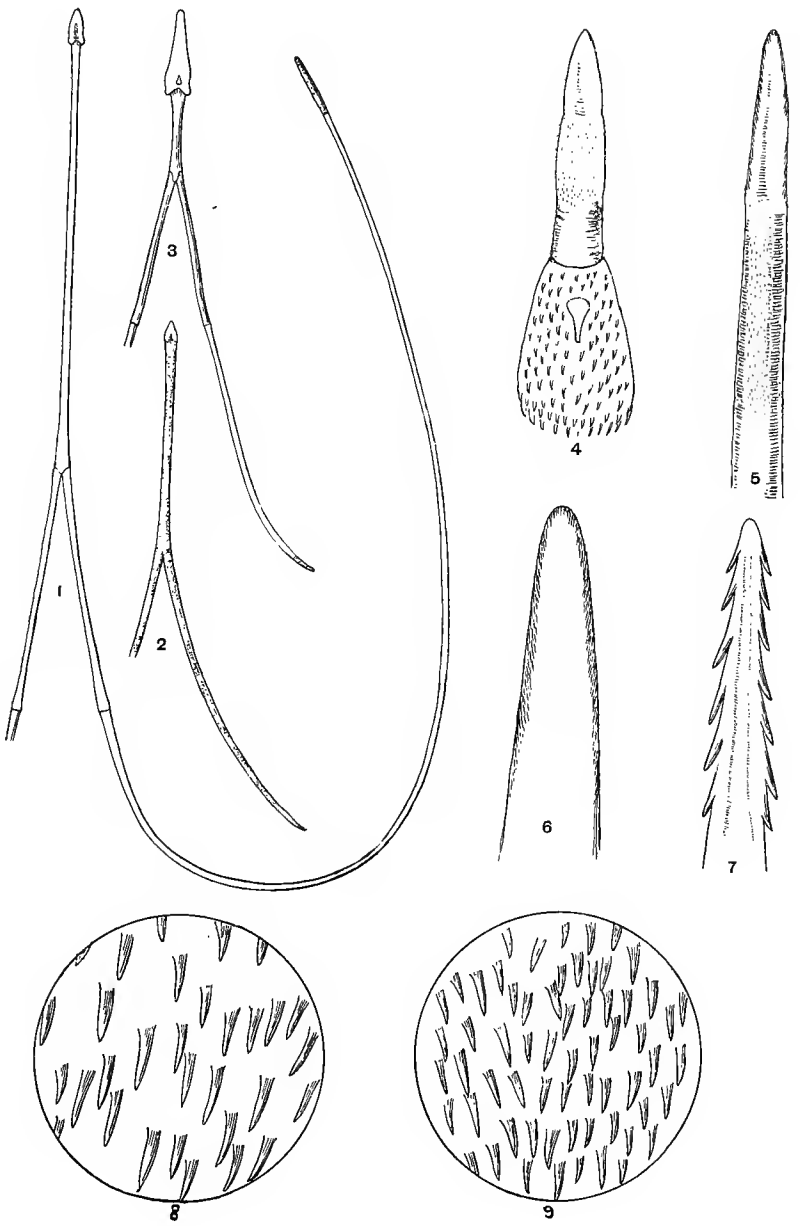




TONGUES OF WOODPECKERS.

PLATE III.

Fig. 1. Hyoid of Flicker (*Colaptes auratus*) (adult, × 2).
2. Hyoid of Flicker (*Colaptes auratus*) (recently hatched, × 2).
3. Hyoid of Red-naped Sapsucker (*Sphyrapicus varius nuchalis*) (× 2).
4. Tongue of recently hatched Downy Woodpecker (*Dryobates pubescens*) (× 4).
5. Tongue of fully-fledged nestling of Downy Woodpecker (*Dryobates pubescens*) (× 3½).
6. Tip of tongue of fully-fledged nestling of Downy Woodpecker (*Dryobates pubescens*) (× 6).
7. Tip of tongue of adult Downy Woodpecker (*Dryobates pubescens*) (× 6¾).
8. Spines from dorsal tract of tongue of Red-headed Woodpecker (*Melanerpes erythrocephalus*) (greatly enlarged).
9. Spines from dorsal tract of tongue of Ladder-back Woodpecker (*Dryobates scalaris*) (greatly enlarged).



TONGUES OF WOODPECKERS.

THE BLUE JAY AND ITS FOOD.

BY

F. E. L. BEAL,

Assistant Biologist, U. S. Department of Agriculture.

[REPRINTED FROM THE YEARBOOK OF THE DEPARTMENT OF AGRICULTURE FOR 1896.]

THE BLUE JAY AND ITS FOOD.

By F. E. L. Beal,
Assistant Biologist, U. S. Department of Agriculture.

GENERAL REMARKS.

Of the various birds that enliven the groves and orchards, few are more conspicuous than the common blue jay (*Cyanocitta cristata*) (fig. 40). Its loud and rather harsh voice, striking colors, and obtrusive actions attract attention when other birds equally abundant remain unnoticed. An accurate knowledge of its food habits is a matter of some importance from an economic point of view, since the bird is abundant and feeds largely upon grain and other hard seeds, although the proportion supplied by the farmer's crops has never been accurately determined. It has also been shown that the jay occasionally

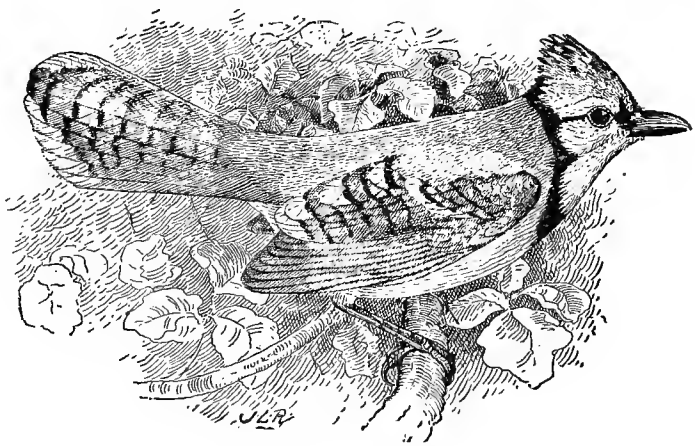


Fig. 40.—The common blue jay.

preys upon the eggs or young of other birds, and some observers have declared it an habitual nest robber and thief, but the extent of its nest-robbing proclivities is unknown, and a detailed examination of its food is necessary in order to throw more light on these points.

The blue jay is distributed over the whole of the United States east of the Great Plains, from the Gulf of Mexico to Manitoba and Newfoundland. It remains constant in form and color throughout most of this region, except in Florida and along the Gulf coast, where a smaller race (*Cyanocitta cristata florincola*) occurs. While jays commonly resort to the forest to breed, they do not by any means confine themselves to the woods, but visit orchards, meadows, gardens, and

farmyards in search of food. They remain throughout the year in most parts of their range, and their beautiful blue plumage is particularly conspicuous in the fall and winter months, when the trees are partly or wholly denuded of foliage. Their sauey, independent airs, sprightly manners, brilliant colors, and jaunty, plumed caps have gained them many friends, in spite of the fact that their food habits are supposed to be somewhat detrimental to the interests of the farmer. So completely is this latter faet forgotten in the gloom and nakedness of winter that it is a common practice in many places, notably in New England, to place beds of chaff upon the snow into which corn is scattered each day in order to attract the jays. When the ground is well covered with its wintry fleece, they may be seen at all hours of the day eagerly pecking in the chaff for the welcome morsels, and their presence in the garden and on the lawn relieves to some extent the winter dearth of bird life.

The vocal powers of this bird, while by no means to be despised, are not as pleasing as is its plumage, and most of its notes can be considered agreeable only by association. Jays are more or less garrulous all the year, but are particularly noisy at harvest time when laying up a supply of food for winter. They also exhibit considerable powers of mimicry and imitate the notes of many other birds with considerable success. One which was kept in captivity by Mr. Sylvester D. Judd learned to pronounce several English names distinetly, as well as to give a schoolboy's yell and to whistle for a dog.

Blue jays have been charged with eating grain, devouring fruit, and destroying the eggs and young of other birds. It is also asserted that they devour numerous insects, and thus to some extent counterbalance the harm they do. Many eases of nest robbing might be eited, but it will be sufficient to give a few notes of field observers.

Mr. Henry M. Berry, of Iowa City, Iowa, elaims to have seen blue jays suck the contents of four eggs of the wood thrush while the old bird was only a few feet distant doing its best to drive them away.

Mr. B. F. Goss, of Pewaukee, Wis., declares that they are the worst robbers of all, and that their destruetion of the eggs and young of small birds is appalling.

Mr. T. J. Bull, of Hot Springs, Ark., writes: "While standing on the observatory on Hot Springs Mountain, I saw beneath me a pair of redbirds chirping in great distress, and also noticed a blue jay fly away. Upon looking more closely, I discovered a nest with one young bird in it. * * * In about half an hour the jay returned to the nest, picked up the young bird, and flew away with it."

In view of such explicit testimony from observers whose accuracy can not be impeached, special pains have been taken to ascertain how far the charges were sustained by a study of the bird's food. An examination was made of 292 stomaehs collected in every month of the year from 22 States, the District of Columbia, and Canada.

EXAMINATION OF STOMACH CONTENTS.

One of the first points to attract attention in examining these stomachs was the large quantity of mineral matter, averaging over 14 per cent of the total contents. The real food is composed of 24.3 per cent of animal matter and 75.7 per cent of vegetable matter, or a trifle more than three times as much vegetable as animal (fig. 41). The animal food is chiefly made up of insects, with a few spiders, myriapods, snails, and small vertebrates, such as fish, salamanders, tree frogs, mice, and birds. Everything was carefully examined which might by any possibility indicate that birds or eggs had been eaten, but remains of birds were found in only 2, and the shells of small birds' eggs in 3 of the 292 stomachs. One of these, taken on February 10, contained the bones, claws, and a little skin of a bird's foot. Another,

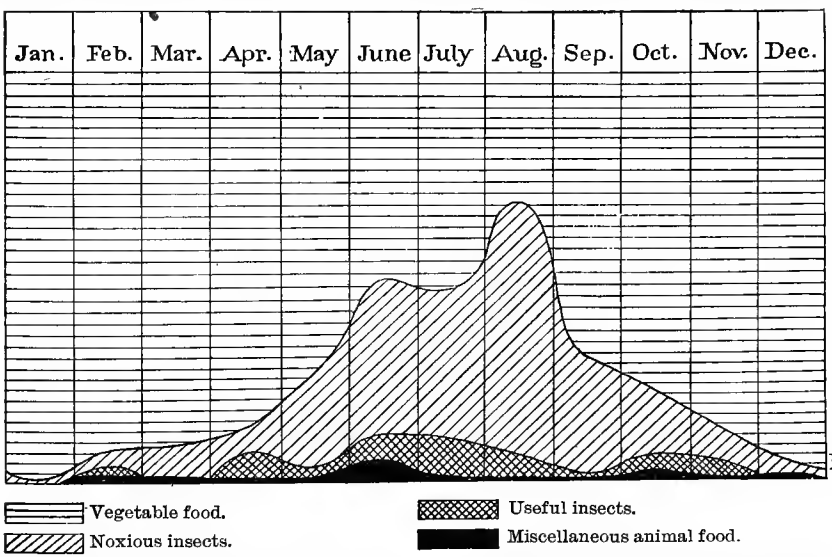


FIG. 41.—Diagram showing the relative amounts of vegetable and animal food eaten by the blue jay in each month of the year. The vegetable food is represented by the area above the line A B; the animal food by the space below.

taken on June 24, contained remains of a young bird. The three stomachs with birds' eggs were collected in June, August, and October, respectively. The shell eaten in October belonged to the egg of some larger bird like the ruffed grouse, and considering the time of year, was undoubtedly merely an empty shell from an old nest. Shells of eggs which were identified as those of domesticated fowls, or some bird of equal size, were found in 11 stomachs, collected at irregular times during the year. This evidence would seem to show that more eggs of domesticated fowls than of wild birds are destroyed, but it is much more probable that these shells were obtained from refuse heaps about farmhouses.

To reconcile such contradictory evidence is certainly difficult, but it seems evident that these nest-robbing propensities are not as general as has been heretofore supposed. If this habit were as prevalent as some writers have asserted, and if it were true that eggs and young of smaller birds constitute the chief food of the blue jay during the breeding season, the small birds of any section where jays are fairly abundant would be in danger of extermination.

The ease with which a bird's actions may be misinterpreted is well illustrated by the case of a stomach which was received with the legend "Eating robins' eggs," but which, upon rigid examination, failed to reveal even a minute trace of an egg. It is of course possible for a bird to eat an egg without swallowing any portion of the shell, in which case the soft contents would soon disappear from the stomach, but in view of the fact that such substances as dead leaves, bits of plant stems, and rotten wood, which are evidently swallowed accidentally with insects or other food, are constantly found in birds' stomachs, it does not seem probable that blue jays would discriminate against eggshells. To test this matter, four eggs of the English sparrow were offered to a jay in captivity. The bird at once seized the eggs and began to eat them, but when any piece of the shell, no matter how minute, was accidentally dropped it was at once picked up and swallowed, and several such pieces that were thrown to the farther end of the cage were also eaten, so that the shells with their membranes were entirely gone before the soft contents.

Besides birds, remains of small vertebrates were found in twelve stomachs, as follows: Fish and salamanders in one stomach each, tree frogs in four, mice in five, and a shrew in one. It is perhaps worthy of note that Dr. B. H. Warren failed to find a trace of any vertebrate remains in examining twenty-three stomachs of the blue jay, fourteen of which were collected in May, one in June, three in September, and five in October. (Birds of Pennsylvania, pp. 200–201.)

The jay kept in captivity by Mr. Judd showed a marked fondness for mice, and would devour them apparently with great relish. Another bird ate only a portion of dead mice and refused to touch live mice, preferring insects when it had an opportunity for choice.

INSECT FOOD.

Insects are eaten by blue jays in every month in the year, but naturally only in small quantities during the winter. The great bulk of the insect food consists of beetles, grasshoppers, and caterpillars, with a few bugs, wasps, and flies, and an occasional spider and myriapod. The average for the whole year is nearly 23 per cent, varying from less than 1 per cent in January to over 66 per cent in August, and gradually diminishing to 3.2 per cent in December. There is a remarkable increase in the quantities eaten in spring and summer, the percentage increasing from 28 in May to 44 in June, and from 46 in July to

66.3 in August. The molting season may account for the increase in August, but that in June is not so easily explained. The beetles found in the stomachs may be roughly divided into three groups: Predaceous beetles (Carabids); those belonging to the May beetle family (Scarabæids); and miscellaneous beetles, including about half a dozen families. Each of these groups forms a little more than 3½ per cent of the food. The greatest number of predaceous beetles were eaten in July, when they aggregated 10.25 per cent of the food of the month. The Carabids belong for the most part to genera with blunt jaws, such as *Harpalus*, *Cratacanthus*, and *Stenolophus;* only a few specimens with sharp jaws like *Pasimachus*, *Galerita*, and *Calosoma* were found, and it is probable that no great harm is done by the destruction of these beetles, as they are not entirely carnivorous and are therefore less useful, and the individuals are abundant.

Scarabæids reach their maximum abundance in the jay's food in August (11.8 per cent), although nearly as many (11 per cent) were eaten in June. They were mostly represented by the larger species, such as the goldsmith beetle (*Cotalpa lanigera*), the spotted grapevine beetle (*Pelidnota punctata*), the brilliant tumblebug (*Phanæus carnifex*), with many May beetles (*Lachnosterna*), and quite a large number of fruit-eating beetles (*Euphoria inda* and *E. fulgida*). At least five specimens of *Euphoria inda* were found in one stomach, amounting to 75 per cent of the whole food contents. It is worthy of notice that one stomach contained a nearly perfect specimen of the grapevine beetle and also the seeds and skins of the wild grape (*Vitis cordifolia*), and it seems probable that the bird visited the vine to feed upon the grapes, but finding the beetle swallowed that also. Beetles belonging to other families aggregate 16.3 per cent in June, the most important being a few leaf-eating beetles (Chrysomelidæ), some click beetles (Elateridæ), and a number of curculios (Curculionidæ). A dozen curculios, belonging to the genus *Balaninus*, were found in a single stomach, and three in another. As these beetles live on acorns and other nuts, it seems probable that the birds devoured them when looking for their favorite food, mast.

Grasshoppers, crickets, and locusts form about 4.4 per cent of the food; but they do not become an important element until July. They attain their maximum of 19.5 per cent in August, and continue in considerable numbers until December. If June can be called the beetle month in the dietary of the jay, August is the grasshopper month; and birds that eat these insects at all eat the greatest quantity at this time. Many birds that live during the rest of the year on food obtained from trees or shrubs come to the ground and feed upon grasshoppers in August. Caterpillars form an important element only in March, August, and September, and the greatest number, amounting to 11.4 per cent, were eaten in August. The kind of caterpillars eaten is of more interest than the number. The jay

apparently likes to take its food in large morsels, and as in the case of beetles, large larvæ, like those of the humming-bird moths (Sphingidæ), are selected whenever obtainable. In several cases a single specimen of these caterpillars more than 2 inches in length and nearly as large as one's finger was snugly coiled up in the stomach, almost filling the whole cavity. Eggs of insects were frequent, and those of the tent caterpillar moth (*Clisiocampa americana*) occurred in four cases. Dr. J. A. Allen has found these eggs in blue jay stomachs (Auk, XII, Oct., 1895, p. 383), and many years ago Dr. J. P. Kirtland called attention to the usefulness of this bird in destroying the larvæ of the tent caterpillar (Atlantic Monthly, XXV, Apr., 1870, p. 482). Many of the smaller species of caterpillars were quite hairy, and others rough and warty, showing that this does not render them objectionable. Mr. E. H. Forbush credits the blue jay with eating great numbers of eggs, pupæ, and larvæ of the gypsy moth, and he observed them carrying away the larvæ, which are hairy caterpillars of considerable size, apparently to feed their young. (Rept. on Gypsy Moth, Mass. Board Agr., 1896, pp. 214, 215.)

Insects of several other orders were found in nearly every month, and in July and August amounted to a little more than 11 per cent. Hymenoptera were represented by wasps and a few ants. One stomach contained a specimen of the pigeon horntail (*Tremex columba*), a very injurious wood-boring insect. Diptera, or flies, were found in only three stomachs. Hemiptera were represented by quite a number of stink bugs (Pentatomids), a few cicadas, and remains of coccids, or bark lice, which were found in two stomachs. Spiders occur frequently, myriapods occasionally, and snail shells were found in thirty-eight stomachs.

VEGETABLE FOOD.

As already stated, three-fourths of the blue jay's food consists of vegetable matter, which may be conveniently arranged in several groups: (1) Grain, mast, and seeds; (2) fruit; and, (3) miscellaneous.

LIST OF VEGETABLE SUBSTANCES FOUND IN STOMACHS OF THE BLUE JAY.

Grain and mast.—Corn, wheat, oats, buckwheat, acorns, chestnuts, beechnuts, hazelnuts, sumac (*Rhus*), knotweed (*Polygonum*), sorrel (*Rumex*).

Fruit and miscellaneous.—Apples, strawberries, currants (*Ribes rubrum*), blackberries (*Rubus*), mulberries (*Morus*), blueberries (*Vaccinium*), huckleberries (*Gaylussacia*), wild cherries (*Prunus serotina*), chokecherries (*Prunus virginiana*), wild grapes (*Vitis cordifolia*), service berries (*Amelanchier canadensis*), elderberries (*Sambucus canadensis*), sour-gum berries (*Nyssa aquatica*), hawthorn (*Cratægus*), chokeberries (*Aronia arbutifolia*), pokeberries (*Phytolacca decandra*), oak galls, mushrooms, tubers.

Grain is naturally one of the most important groups, and may be considered first. Wheat, oats, and buckwheat occur so seldom and in such small quantities (1.3 per cent of the whole food) that they may be dismissed with slight comment. Wheat was found in only eight stomachs, oats in two, and buckwheat in one. The wheat was eaten in July, August, and September; oats in March and July, and buckwheat in October. Corn was found in seventy-one stomachs, and aggregates 17.9 per cent of the food of the year. This is less than that eaten by the crow (21 per cent) or by the crow blackbird (35 per cent). In January the amount consumed reached nearly 56 per cent. It is perhaps fair to add, however, that about one-third of the stomachs taken in that month were from birds shot at a cornerib when the ground was covered with 3 feet of snow, and do not fairly represent the food of the month. Corn was also found in considerable quantities in February, April, May, and September.

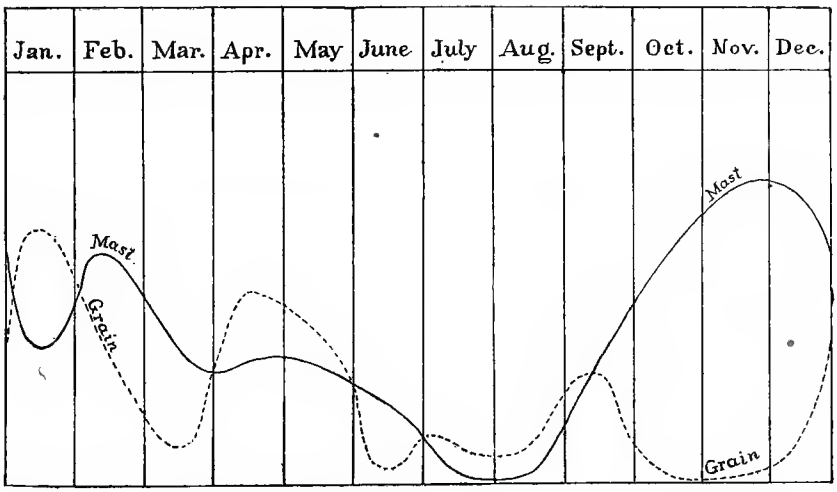


FIG. 42.—Diagram showing the relative amounts of grain and mast eaten by the blue jay in each month of the year.

Under the term "mast" are grouped large seeds of trees and shrubs, such as acorns, chestnuts, beechnuts, and others less conspicuous to the ordinary observer. Unlike corn, it formed a remarkably constant element, and aggregated more than 42 per cent of the whole food of the year. It was found in 168 stomachs, and varied from one-fourth to three-fourths of the total food in every month except July and August. The fact that it is eaten, not only in the late fall, winter, and early spring, when other food may be hard to obtain, but also throughout late spring, summer, and early fall, when fruit, grain, and insects are abundant, would seem to show that it is preferred. The consumption of mast exceeds that of corn in every month except January, April, July, and August; but only a small amount of either is eaten in these last two months. The test as to whether corn is preferred to mast

would seem to be furnished by the record in October and November. It must be admitted that throughout most parts of the blue jay's range both corn and mast are equally accessible during these two months. The cornfields are ripe for the harvest, and lie open and unprotected, where the birds can gather their fill without let or hindrance. The forests also furnish an incalculable quantity of acorns, chestnuts, chinquapins, and beechnuts, while the hedges and river banks teem with hazelnuts, and there seems no reason why the jays should not eat the food that they like. An examination of the stomachs will indicate best what they have actually eaten (fig. 42). Seventy-two stomachs taken in October show an average of over 64 per cent of mast, and eleven collected in November nearly 82 per cent, while the corn in each month aggregates only 1.1 and 0.9 per cent, respectively. It seems scarcely possible to draw any other conclusion than that the blue jays prefer mast to corn, or indeed to any other vegetable food, for they eat the greatest amount at a time when fruit, grain, and other things are most abundant. The record for December shows that the taste for mast, far from being satisfied, has rather increased, and attains its maximum of almost 83 per cent; while only 10 per cent of corn has been taken instead of several other seeds and fruits which were eaten earlier in the season. It was the custom of the writer, at his home in Massachusetts, to bait the blue jays in winter with chaff and corn in the manner already mentioned, and he observed that the birds patronized these feeding places only so long as the ground was completely covered with snow. No sooner did any considerable area of bare surface appear than the corn was discarded and no more birds were seen on the chaff until the earth was again covered with snow. The natural inference was that the jays found something on the bare ground, presumably mast, which they preferred to corn. It is possible that this fondness for mast may affect the distribution of certain trees to some extent. A jay flying with a nut in its beak may drop it in mid-air or carry it away and perhaps store it for future use. Acorns and other nuts may be distributed in this way, and it is probable that many isolated oaks and chestnuts owe their origin to accidents of this kind.

Jays show considerable taste in the choice of fruit. Apples were eaten only during January, February, and March, and consequently were merely frozen fruit left on the trees to decay, which should perhaps be reckoned as refuse rather than food. In the month of March the consumption is greatest, amounting to more than 32 per cent. Fresh fruit is eaten to a slight extent in May, but the quantity increases rapidly in June, and attains more than 39 per cent in July, and then gradually diminishes until it disappears entirely after October. The jay is often included with other birds in the charge of habitual stealing of cultivated fruit. Discarding apples which have no value, only four kinds of fruit are eaten which may be cultivated, namely, strawberries, currants, blackberries, and mulberries. No

cultivated cherries or grapes were found. Strawberries were found in three stomachs, currants in seven, blackberries in twenty-two, and mulberries in five. This certainly does not show great depredations upon fruit, even supposing that all the fruit was cultivated; but it is probable, especially in the case of blackberries, that much of it was wild.

Other vegetable substances were not eaten extensively, but appear to have been taken merely in default of something better. It is worthy of notice that the sumac seeds eaten are those of the harmless staghorn (*Rhus hirta*) and smooth sumac (*Rhus glabra*). Jays do not eat the seeds of poison ivy (*Rhus radicans*) or poison sumac (*Rhus vernix*), and in this respect differ greatly from the crow, the crow blackbird, and some of the woodpeckers. These last, and probably many other birds, feed largely upon sumac seeds during the winter, and thereby help to disseminate these disagreeable and harmful shrubs. It seems a little singular that a bird so fond of hard seeds as the jay should not avail itself of this food, which is always accessible in the colder months, but it is fortunate that it does not eat the seeds of the poisonous species. Remains of galls which grow on oak leaves were found in twelve stomachs, and possibly were eaten for the sake of the larvæ which they contained. Fragments of mushrooms were identified in seven stomachs, mostly taken in April and October.

EXPERIMENTS ON A BLUE JAY IN CAPTIVITY.

The examination of stomach contents was supplemented by experiments on a bird which had been in captivity but a few months and had no acquired tastes. In eating, this jay held its food on the perch usually with the right foot, but sometimes with both feet, and proceeded to tear it to pieces and devour it; hard substances, like kernels of corn and acorns, were repeatedly hammered with the beak after the manner of a woodpecker. It would eat dead mice to a certain extent, but did not appear to be extravagantly fond of them; it seldom or never ate a whole one, and seemed to prefer the brains to any other part. A live mouse was placed in the cage, but remained unmolested for two days. The jay was kept supplied with mocking-bird food, of which it ate freely, so that it was not hungry, and therefore selected only such other food as was appetizing. It ate most insects and preferred them to vegetable food. Its preferences were not strongly marked, although grasshoppers seemed to be the favorite insects, and black crickets were refused. Among beetles, Scarabæids were rather preferred to Carabids or Tenebrionids, but all were eaten. Chrysomelids were generally rejected, and the potato beetle (*Doryphora 10-lineata*) was always refused; the same was true of the elm leaf-beetle (*Galerucella luteola*), but one 12-spotted cucumber beetle (*Diabrotica 12-punctata*) was eaten. Click beetles (Elaterids and Tenebrionids) were apparently preferred to the long-horn beetles (Cerambycids).

On one occasion a basin of water was placed in the cage containing several Carabids (*Harpalus caliginosus* and *H. pennsylvanicus*), one Cerambycid (*Typocerus sinuatus*), one potato beetle (*Doryphora 10-lineata*), another Chrysomelid (*Chrysochrus auratus*), one black cricket, one large hairy caterpillar, and a large milleped (*Julus*). The milleped was taken first, the Carabids next, and finally all the insects were eaten except the Chrysomelids and the cricket.

Very large hard beetles, like *Alaus oculatus*, *Hydrophilus triangularis*, and *Passalus cornutus*, were not often touched, but in default of other insects were torn to pieces and the soft parts separated from the harder portions. Stink bugs (Pentatomids) seemed to be relished, but hairy caterpillars were only taken after most of the hair had been beaten off. Cocoons of a tussock moth were torn open to get the pupæ, and the large green warty caterpillars of the Ailanthus moth were eaten, but with no great relish. In several cases spiders were selected in preference to insects. Myriapods and earthworms were eaten less readily than sow bugs (*Oniscus*).

The bird would eat corn and sprouted acorns, but did not seem to care much for them. It ate apples, blackberries, and black raspberries, but rejected red raspberries, strawberries, mulberries, and elderberries; it swallowed the pulp of grapes only after removing the skin and seeds, and also ate a little peach pulp, but without great relish.

SUMMARY.

The most striking point in the study of the food of the blue jay is the discrepancy between the testimony of field observers concerning the bird's nest-robbing proclivities and the results of stomach examinations. The accusations of eating eggs and young birds are certainly not sustained, and it is futile to attempt to reconcile the conflicting statements on this point, which must be left until more accurate observations have been made. In destroying insects the jay undoubtedly does much good. Most of the predaceous beetles which it eats do not feed on other insects to any great extent. On the other hand, it destroys some grasshoppers and caterpillars and many noxious beetles, such as Scarabæids, click beetles (Elaterids), weevils (Curculionids), Buprestids, Chrysomelids, and Tenebrionids. The blue jay gathers its fruit from nature's orchard and vineyard, not from man's; corn is the only vegetable food for which the farmer suffers any loss, and here the damage is small. In fact, the examination of nearly 300 stomachs shows that the blue jay certainly does far more good than harm.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 54.

SOME COMMON BIRDS

IN THEIR RELATION TO AGRICULTURE.

BY

F. E. L. BEAL, B. S.,
ASSISTANT ORNITHOLOGIST, BIOLOGICAL SURVEY.

[May, 1897.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.

CONTENTS

SOME COMMON BIRDS IN THEIR RELATION TO AGRICULTURE.

INTRODUCTION.

It has long been known that birds play an important part in relation to agriculture, but there seems to be a tendency to dwell on the harm they do rather than on the good. Whether a bird is injurious or beneficial depends almost entirely upon what it eats, and in the case of species which are unusually abundant or which depend in part upon the farmer's crops for subsistence the character of the food often becomes a very practical question. If crows or blackbirds are seen in numbers about cornfields, or if woodpeckers are noticed at work in an orchard, it is perhaps not surprising that they are accused of doing harm. Careful investigation, however, often shows that they are actually destroying noxious insects, and also that even those which do harm at one season may compensate for it by eating noxious species at another. Insects are eaten at all times by the majority of land birds, and during the breeding season most kinds subsist largely and rear their young exclusively on this food. When insects are unusually plentiful, they are eaten by many birds which ordinarily do not touch them. Even birds of prey resort to this diet, and when insects are more easily obtained than other fare, the smaller hawks and owls live on them almost entirely. This was well illustrated during the recent plague of Rocky Mountain locusts in the Western States, when it was found that locusts were eaten by nearly every bird in the region, and that they formed almost the entire food of a large majority of the species.

Within certain limits, birds feed upon the kind of food that is most accessible. Thus, as a rule, insectivorous birds eat the insects that are most easily obtained, provided they do not have some peculiarly disagreeable property. It is not probable that a bird habitually passes by one kind of insect to look for another which is more appetizing, and there seems little evidence in support of the theory that the selection of food is restricted to any particular species of insect, for it is evident that a bird eats those which by its own method of seeking are most easily obtained. Thus, a ground-feeding bird eats those it finds among the dead leaves and grass; a flycatcher, watching for its prey from some vantage point, captures entirely different kinds; and the

woodpecker and warbler, in the tree tops, select still others. It is thus apparent that a bird's diet is likely to be quite varied, and to differ at different seasons of the year.

In investigating the food habits of birds, field observation can be relied on only to a limited extent, for it is not always easy to determine what a bird really eats by watching it. In order to be positive on this point, it is necessary to examine the stomach contents. When birds are suspected of doing injury to field crops or fruit trees, a few individuals should be shot and their stomachs examined. This will show unmistakably whether or not the birds are guilty.

In response to a general demand for definite information regarding the food habits of our native birds, the Biological Survey of the Department of Agriculture has for some years past been conducting a systematic investigation of the food of species which are believed to be of economic importance. Thousands of birds' stomachs have been carefully examined in the laboratory, and all the available data respecting the food brought together. The results of the investigations relating to birds of prey, based on an examination of nearly 3,000 stomachs, were published in 1893, in a special bulletin entitled The Hawks and Owls of the United States. Many other species have been similarly studied and the results published, either in special bulletins or as articles in the yearbooks. The present bulletin contains brief abstracts of the results of food studies of about 30 grain and insect eating birds belonging to 10 different families.[1]

These species comprise among others the crow blackbirds and ricebirds, against which serious complaints have been made on account of the damage they do to corn, wheat, rice, and other crops; and also the cuckoos, grosbeaks, and thrashers, which are generally admitted to be beneficial, but whose true value as insect destroyers has not been fully appreciated. The practical value of birds in controlling insect pests should be more generally recognized. It may be an easy matter to exterminate the birds in an orchard or grain field, but it is an extremely difficult one to control the insect pests. It is certain, too, that the value of our native sparrows as weed destroyers is not appreciated. Weed seed forms an important item of the winter food of many of these birds, and it is impossible to estimate the immense numbers of noxious weeds which are thus annually destroyed.

[1] The limits of this bulletin preclude giving more than a very brief statement regarding the food of each bird, but more detailed accounts of some of the species will be found in the following reports of the Biological Survey (formerly Division of Ornithology and Mammalogy): The Crow—Bulletin No. 6, 1895, pp. 1–98; Woodpeckers—Bulletin No. 7, 1895, pp. 1–39; Kingbird—Annual Report Secretary of Agriculture, for 1893, pp. 233–234; Baltimore Oriole—Yearbook United States Department of Agriculture for 1895, pp. 426–430; Grackles—Yearbook for 1894, pp. 233–248; Meadowlark—Yearbook for 1895, pp. 420–426; Cedarbird—Annual Report Secretary of Agriculture, for 1892, pp. 197–200; Catbird, Brown Thrasher, and Wren—Yearbook for 1895, pp. 405–418.

If birds are protected and encouraged to nest about the farm and garden, they will do their share in destroying noxious insects and weeds, and a few hours spent in putting up boxes for bluebirds, martins, and wrens will prove a good investment. Birds are protected by law in many States, but it remains for the agriculturists to see that the laws are faithfully observed.

THE CUCKOOS.

(*Coccyzus americanus* and *C. erythrophthalmus*.)

Two species of cuckoos, the yellow-billed (fig. 1) and the black-billed, are common in the United States east of the Plains, and a subspecies of the yellow-billed extends westward to the Pacific. While the two species are quite distinct, they do not differ greatly in food habits, and their economic status is practically the same.

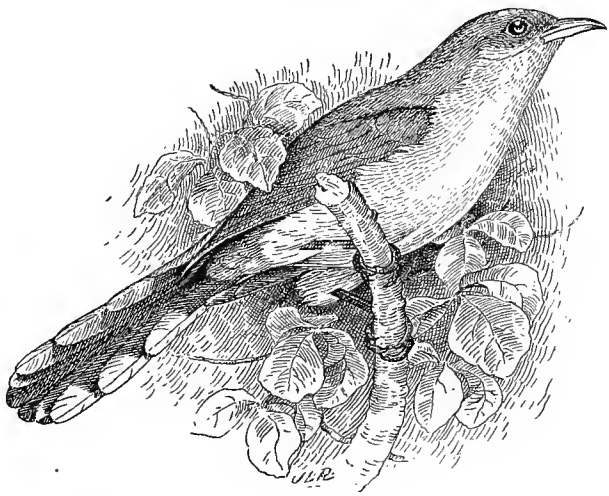


FIG. 1.—Yellow-billed cuckoo.

An examination of 37 stomachs has shown that these cuckoos are much given to eating caterpillars, and, unlike most birds, do not reject those covered with hair. In fact, cuckoos eat so many hairy caterpillars that the hairs pierce the inner lining of the stomach and remain there, so that when the stomach is opened and turned inside out, it appears to be lined with a thin coating of fur.

An examination of the stomachs of 16 black-billed cuckoos, taken during the summer months, showed the remains of 328 caterpillars, 11 beetles, 15 grasshoppers, 63 sawflies, 3 stink bugs, and 4 spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy, and many of them belonged to a genus that lives in colonies and feeds on the leaves of trees, including the apple tree. One stomach was filled with larvæ of a caterpillar belonging to the

same genus as the tent caterpillar, and possibly to that species. Other larvæ were those of large moths, for which the bird seems to have a special fondness. The beetles were for the most part click beetles and weevils, with a few May beetles and some others. The sawflies were all found in two stomachs, one of which contained no less than 60 in the larval stage.

Of the yellow-billed cuckoo, 21 stomachs (collected from May to October, inclusive) were examined. The contents consisted of 355 caterpillars, 18 beetles, 23 grasshoppers, 31 sawflies, 14 bugs, 6 flies, and 12 spiders. As in the case of the black-billed cuckoo, most of the caterpillars belonged to hairy species and many of them were of large size. One stomach contained 12 American tent caterpillars; another 217 fall webworms. The beetles were distributed among several families, but all more or less harmful to agriculture. In the same stomach which contained the tent caterpillars were two Colorado potato beetles; in another were three goldsmith beetles and remains of several other large beetles. Besides ordinary grasshoppers were several katydids and tree crickets. The sawflies were in the larval stage, in which they resemble caterpillars so closely that they are commonly called false caterpillars by entomologists, and perhaps this likeness may be the reason the cuckoos eat them so freely. The bugs consisted of stink bugs and cicadas or dog-day harvest flies, with the single exception of one wheel bug, which was the only useful insect eaten, unless the spiders be counted as such.

THE WOODPECKERS.

Five or six species of woodpeckers are familiarly known throughout the eastern United States, and in the west are replaced by others of similar habits. Several species remain in the northern States through the entire year, while others are more or less migratory.

Farmers are prone to look upon woodpeckers with suspicion. When the birds are seen scrambling over fruit trees and pecking at the bark, and fresh holes are found in the tree, it is concluded that they are doing harm. Careful observers, however, have noticed that, excepting a single species, these birds rarely leave any important mark on a healthy tree, but that when a tree is affected by wood-boring larvæ the insects are accurately located, dislodged, and devoured. In case the holes from which the borers are taken are afterwards occupied and enlarged by colonies of ants, these ants in turn are drawn out and eaten.

Two of the best known woodpeckers, the hairy woodpecker (*Dryobates villosus*) (fig. 2) and the downy woodpecker (*D. pubescens*), including their races, range over the greater part of the United States, and for the most part remain throughout the year in their usual haunts. They differ chiefly in size, for their colors are practically the same, and the males, like other woodpeckers, are distinguished by a scarlet patch

An examination of many stomachs of these two birds shows that from two-thirds to three-fourths of the food consists of insects, chiefly noxious. Wood-boring beetles, both adults and larvæ, are conspicuous, and with them are associated many caterpillars, mostly species that burrow into trees. Next in importance are the ants that live in decaying wood, all of which are sought by woodpeckers and eaten in great quantities. Many ants are particularly harmful to timber, for if they find a small spot of decay in the vacant burrow of some woodborer, they enlarge the hole, and as their colony is always on the increase, continue to eat away the wood until the whole trunk is honeycombed. Moreover, these insects are not accessible to other birds, and could pursue their career of destruction unmolested were it not that the woodpeckers, with beaks and tongues especially fitted for such work, dig out and devour them. It is thus evident that woodpeckers are great conservators of forests. To them, more than to any other agency, we owe the preservation of timber from hordes of destructive insects.

FIG. 2.—Hairy woodpecker.

One of the larger woodpeckers familiar to everyone is the flicker, or golden-winged woodpecker (*Colaptes auratus*) (fig. 3), which is generally distributed throughout the United States from the Atlantic Coast to

the Rocky Mountains. It is there replaced by the red-shafted flicker (*C. cafer*), which extends westward to the Pacific. The two species are as nearly identical in food habits as their environment will allow. The flickers, while genuine woodpeckers, differ somewhat in habits from the rest of the family, and are frequently seen upon the ground searching for food. Like the downy and hairy woodpeckers, they eat wood-boring grubs and ants, but the number of ants eaten is much greater. Two of the flickers' stomachs examined were completely filled with ants, each stomach containing more than 3,000 individuals. These ants belonged to species which live in the ground, and it is these insects for which the flicker is searching when running about in the grass, although some grasshoppers are also taken.

FIG. 3.—Flicker.

The red headed woodpecker (*Melanerpes erythrocephalus*) (fig. 4) is well known east of the Rocky Mountains, but is rather rare in New England. Unlike some of the other species, it prefers fence posts and telegraph poles to trees as a foraging ground. Its food therefore naturally differs from that of the preceding species, and consists largely of adult beetles and wasps, which it frequently captures on the wing, after the fashion of flycatchers. Grasshoppers also form an important part of the food. The redhead has a peculiar habit of selecting very large beetles, as shown by the presence of fragments of several of the largest species in the stomachs. Among the beetles were quite a number of predaceous ground beetles, and unfortunately some tiger beetles, which are useful insects. The redhead has been accused of robbing the nests

of other birds; also of attacking young birds and poultry and pecking out their brains, but as the stomachs showed little evidence to substantiate this charge it is probable that the habit is rather exceptional.

It has been customary to speak of the smaller woodpeckers as "sapsuckers," under the belief that they drill holes in the bark of trees for the purpose of drinking the sap and eating the inner bark. Close observation, however, has fixed this habit upon only one species, the yellow-bellied woodpecker, or sapsucker (*Sphyrapicus varius*) (fig 5). This bird has been shown to be guilty of pecking holes in the bark of various forest trees, and sometimes in that of apple trees, from which it drinks the sap

FIG. 4.—Red-headed woodpecker.

when the pits become filled. It has been proved, however, that besides taking the sap the bird captures large numbers of insects which are attracted by the sweet fluid, and that these form a very considerable portion of its diet. In some cases the trees are injured by being thus punctured, and die in a year or two, but since comparatively few are touched the damage is not great. It is equally probable, moreover, that the bird fully compensates for this injury by the insects it consumes.

The vegetable food of woodpeckers is varied, but consists largely of small fruits and berries. The downy and hairy woodpeckers eat such fruits as dogwood, Virginia creeper, and others, with the seeds of

poison ivy, sumac, and a few other shrubs. The flicker also eats a great many small fruits and the seeds of a considerable number of shrubs and weeds. None of the three species is much given to eating cultivated fruits or crops.

The redhead has been accused of eating the larger kinds of fruit, such as apples, and also of taking considerable corn. The stomach examinations show that to some extent these charges are substantiated, but that the habit is not prevalent enough to cause much damage. It is quite fond of mast, especially beechnuts, and when these nuts are

FIG. 5.—Yellow-bellied woodpecker.

plentiful the birds remain north all winter, instead of migrating as is their usual custom.

Half the food of the sapsucker, aside from sap, consists of vegetable matter, largely berries of the kinds already mentioned, and also a quantity of the inner bark of trees, more of which is eaten by this species than by any other.

Many other woodpeckers are found in America, but their food habits agree in the main with those just described. These birds are certainly

the only agents which can successfully cope with certain insect enemies of the forests, and, to some extent, of fruit tree salso. For this reason, if for no other, they should be protected in every possible way.

THE KINGBIRD.

(*Tyrannus tyrannus.*)

The kingbird (fig. 6) is essentially a lover of the orchard, and wherever the native groves have been replaced by fruit trees this pugnacious bird takes up its abode. It breeds in all of the States east of the Rocky Mountains, and less commonly in the Great Basin and on the Pacific Coast. It migrates south early in the fall, and generally leaves the United States to spend the winter in more southern latitudes.

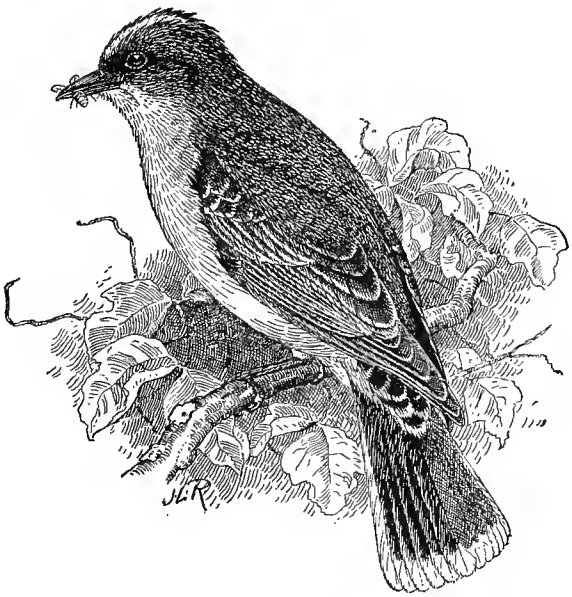


FIG. 6.—Kingbird.

The kingbird manifests its presence in many ways. It is somewhat boisterous and obtrusive, and its antipathy for hawks and crows is well known. It never hesitates to give battle to any of these marauders, no matter how superior in size, and for this reason a family of kingbirds is a desirable adjunct to a poultry yard. On one occasion in the knowledge of the writer a hawk which attacked a brood of young turkeys was pounced upon and so severely buffeted by a pair of kingbirds, whose nest was near by, that the would-be robber was glad to escape without his prey. Song birds that nest near the kingbird are similarly protected.

In its food habits this species is largely insectivorous. It is a true flycatcher by nature, and takes a large part of its food on the wing. It

does not, however, confine itself to this method of hunting, but picks up some insects from trees and weeds, and even descends to the ground in search of myriapods or thousand legs. The chief complaint against the kingbird is that it preys largely upon honeybees; and this charge has been made both by professional bee keepers and others. Many observers have seen the bird at work near hives, and there is no reason to doubt the honesty of their testimony. One bee raiser in Iowa, suspecting the kingbirds of feeding upon his bees, shot a number near his hives, but when the birds' stomachs were examined by an expert entomologist not a trace of honeybees could be found.

The Biological Survey has made an examination of 281 stomachs collected in various parts of the country, but found only 14 containing remains of honeybees. In these 14 stomachs there were in all 50 honeybees, of which 40 were drones, 4 were certainly workers, and the remaining 6 were too badly broken to be identified as to sex.

The insects that constitute the great bulk of the food of this bird are noxious species, largely beetles—May beetles, click beetles (the larvæ of which are known as wire worms), weevils, which prey upon fruit and grain, and a host of others. Wasps, wild bees, and ants are conspicuous elements of the food, far outnumbering the hive bees. During summer many grasshoppers and crickets, as well as leaf hoppers and other bugs, are also eaten. Among the flies were a number of robber flies—insects which prey largely upon other insects, especially honeybees, and which have been known to commit in this way extensive depredations. It is thus evident that the kingbird by destroying these flies actually does good work for the apiarist. Nineteen robber flies were found in the stomachs examined; these may be considered more than an equivalent for the four worker honeybees already mentioned. A few caterpillars are eaten, mostly belonging to the group commonly known as cutworms, all the species of which are harmful. About 10 per cent of the food consists of small native fruits, comprising some twenty common species of the roadsides and thickets, such as dogwood berries, elder berries, and wild grapes. The bird has not been reported as eating cultivated fruit to an injurious extent, and it is very doubtful if this is ever the case, for cherries and blackberries are the only ones that might have come from cultivated places, and they were found in but few stomachs.

Three points seem to be clearly established in regard to the food of the kingbird—(1) that about 90 per cent consists of insects, mostly injurious species; (2) that the alleged habit of preying upon honeybees is much less prevalent than has been supposed, and probably does not result in any great damage; and (3) that the vegetable food consists almost entirely of wild fruits which have no economic value. These facts, taken in connection with its well-known enmity for hawks and crows, entitle the kingbird to a place among the most desirable birds of the orchard or garden.

THE PHŒBE.

(*Sayornis phœbe.*)

Among the early spring arrivals at the North, none are more welcome than the phœbe (fig. 7). Though naturally building its nest under an overhanging cliff of rock or earth, or in the mouth of a cave, its preference for the vicinity of farm buildings is so marked that in the more thickly settled parts of the country the bird is seldom seen at any great distance from a farmhouse except where a bridge spans some stream, affording a secure spot for a nest. Its confiding disposition has rendered it a great favorite, and consequently it is seldom disturbed. It breeds throughout the United States east of the Great Plains, and winters from the South Atlantic and Gulf States southward.

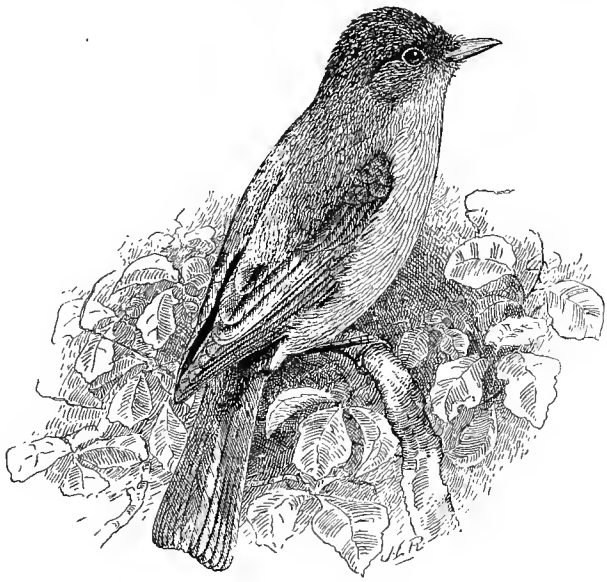


FIG. 7.—Phœbe.

The phœbe subsists almost exclusively upon insects, most of which are caught upon the wing. An examination of 80 stomachs showed that over 93 per cent of the year's food consists of insects and spiders, while wild fruit constitutes the remainder. The insects belong chiefly to noxious species, and include many click beetles, May beetles, and weevils. Grasshoppers in their season are eaten to a considerable extent, while wasps of various species, many flies of species that annoy cattle, and a few bugs and spiders are also eaten regularly. It is evident that a pair of phœbes must materially reduce the number of insects near a garden or field, as the birds often, if not always, raise two broods a year, and each brood numbers from four to six young.

The vegetable portion of the food is unimportant, and consists mainly of a few seeds, with small fruits, such as wild cherries, elder berries, and

juniper berries. The raspberries and blackberries found in the stomachs were the only fruits that might have belonged to cultivated varieties, and the quantity was trifling.

There is hardly a more useful species than the phœbe about the farm, and it should receive every encouragement. To furnish nesting boxes is unnecessary, as it usually prefers a more open situation, like a shed, or a nook under the eaves, but it should be protected from cats and other marauders.

THE BLUE JAY.

(*Cyanocitta cristata.*)

The blue jay (fig. 8) is a common bird of the United States east of the Great Plains, and remains throughout the year in most of its range, although its numbers are somewhat reduced in winter in the Northern States. During spring and summer the jay is forced to become an

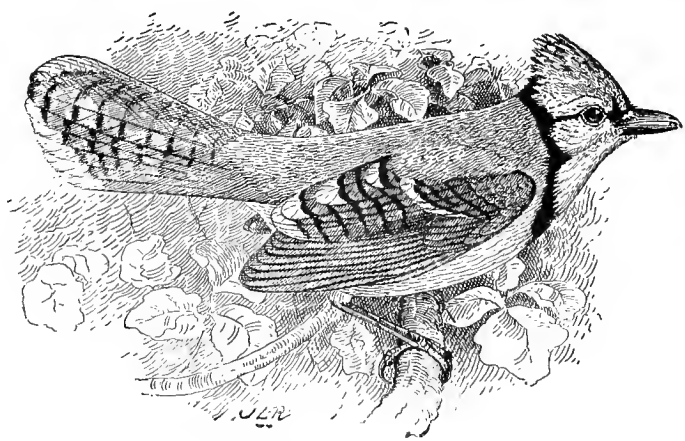


FIG. 8.—Blue jay.

industrious hunter for insects, and is not so conspicuous a feature of the landscape as when it roams the country at will after the cares of the nesting season are over.

Ornithologists and field observers in general declare that a considerable portion of its food in spring and early summer consists of the eggs and young of small birds, and some farmers accuse it of stealing corn to an injurious extent in the fall. While there may be some truth in these accusations, they have almost certainly been exaggerated. No doubt many jays have been observed robbing nests of other birds, but thousands have been seen that were not so engaged.

In an investigation of the food of the blue jay 292 stomachs were examined, which showed that animal matter comprised 24 per cent and vegetable matter 76 per cent of the bird's diet. So much has been said about the nest-robbing habits of the jay that special search was made for traces of birds or birds' eggs in the stomachs, with the result that shells

of small birds' eggs were found in three and the remains of young birds in only two stomachs. Such negative evidence is not sufficient to controvert the great mass of testimony upon this point, but it shows that the habit is not so prevalent as has been believed. Besides birds and their eggs, the jay eats mice, fish, salamanders, snails, and crustaceans, which altogether constitute but little more than 1 per cent of its diet. The insect food is made up of beetles, grasshoppers, caterpillars, and a few species of other orders, all noxious, except some 3½ per cent of predaceous beetles. Thus something more than 19 per cent of the whole food consists of harmful insects. In August the jay, like many other birds, turns its attention to grasshoppers, which constitute nearly one-fifth of its food during that month. At this time, also, most of the other noxious insects, including caterpillars, are consumed, though beetles are eaten chiefly in spring.

The vegetable food is quite varied, but the item of most interest is grain. Corn was found in 70 stomachs, wheat in 8, and oats in 2—all constituting 19 per cent of the total food. Corn is evidently the favorite grain, but a closer inspection of the record shows that the greater part was eaten during the first five months of the year, and that very little was taken after May, even in harvest time, when it is abundant. This indicates that most of the corn is gleaned from the fields after harvest, except what is stolen from cribs or gathered in May at planting time.

The jay's favorite food is mast (i. e., acorns, chestnuts, chinquapins, etc.), which was found in 158 of the 292 stomachs and amounted to more than 42 per cent of the whole food. In September corn formed 15 and mast 35 per cent, while in October, November, and December corn dropped to an almost inappreciable quantity and mast amounted to 64, 82, and 83 per cent, respectively. And yet in these months corn is abundant and everywhere easily accessible. The other elements of food consist of a few seeds and wild fruits, among which grapes and blackberries predominate.

The results of the stomach examination show, (1) that the jay eats many noxious insects; (2) that its habit of robbing the nests of other birds is much less common than has been asserted; and (3) that it does little harm to agriculture, since all but a small amount of the corn eaten is waste grain.

THE CROW.

(*Corvus americanus.*)

There are few birds so well known as the common crow, and unlike most other species he does not seem to decrease in numbers as the country becomes more densely populated. The crow is commonly regarded as a blackleg and a thief. Without the dash and brilliancy of the jay, or the bold savagery of the hawk, he is accused of doing more mischief than either. That he does pull up sprouting corn, destroy chickens, and rob the nests of small birds has been repeatedly

proved. Nor are these all of his sins. He is known to eat frogs, toads, salamanders, and some small snakes, all harmless creatures that do some good by eating insects. With so many charges against him, it may be well to show why he should not be utterly condemned.

The examination of a large number of stomachs, while confirming all the foregoing accusations, has thrown upon the subject a light somewhat different from that derived solely from field observation. It shows that the bird's-nesting habit, as in the case of the jay, is not so universal as has been supposed; and that, so far from being a habitual nest robber, the crow only occasionally indulges in that reprehensible practice. The same is true in regard to destroying chickens, for he is able to carry off none but very young ones, and his opportunities for capturing them are somewhat limited. Neither are many toads and frogs eaten, and as frogs are of no great practical value, their destruction is not a serious matter; but toads are very useful, and their consumption, so far as it goes, must be counted against the crow. Turtles, crayfishes, and snails, of which he eats quite a large number, may be considered neutral, while mice may be counted to his credit.

In his insect food, however, the crow makes amends for sins in the rest of his dietary, although even here the first item is against him. Predaceous beetles are eaten in some numbers throughout the season, but the number is not great. May beetles, "dor-bugs," or June bugs, and others of the same family, constitute the principal food during spring and early summer, and are fed to the young in immense quantities. Other beetles, nearly all of a noxious character, are eaten to a considerable extent. Grasshoppers are first taken in May, but not in large numbers until August, when, as might be expected, they form the leading article of diet, showing that the crow is no exception to the general rule that most birds subsist, to a large extent, upon grasshoppers in the month of August. Many bugs, some caterpillars, mostly cutworms, and some spiders are also eaten—all of them either harmful or neutral in their economic relations. Of the insect diet Mr. E. A. Schwarz says: "The facts, on the whole, speak overwhelmingly in favor of the crow."

Probably the most important item in the vegetable food is corn, and by pulling up the newly sprouted seeds the bird renders himself extremely obnoxious. Observation and experiments with tame crows show that hard, dry corn is never eaten if anything else is to be had, and if fed to nestlings it is soon disgorged. The reason crows resort to newly planted fields is that the kernels of corn are softened by the moisture of the earth, and probably become more palatable in the process of germination, which changes the starch of the grain to sugar. The fact, however, remains that crows eat corn extensively only when it has been softened by germination or partial decay, or before it is ripe and still "in the milk." Experience has shown that they may be prevented from pulling up young corn by tarring the seed, which not only saves the corn but forces them to turn their attention to insects. If

they persist in eating green corn it is not so easy to prevent the damage; but no details of extensive injury in this way have yet been presented, and it is probable that no great harm has been done.

Crows eat fruit to some extent, but confine themselves for the most part to wild species, such as dogwood, sour gum, and seeds of the different kinds of sumac. They have also a habit of sampling almost everything which appears eatable, especially when food is scarce. For example, they eat frozen apples found on the trees in winter, or pumpkins, turnips, and potatoes which have been overlooked or neglected; even mushrooms are sometimes taken, probably in default of something better.

In estimating the economic status of the crow, it must be acknowledged that he does some damage, but, on the other hand, he should receive much credit for the insects which he destroys. In the more thickly settled parts of the country the crow probably does more good than harm, at least when ordinary precautions are taken to protect young poultry and newly-planted corn against his depredations. If, however, corn is planted with no provision against possible marauders, if hens and turkeys are allowed to nest and to roam with their broods at a distance from farm buildings, losses must be expected.

THE BOBOLINK, OR RICEBIRD.

(*Dolichonyx oryzivorus.*)

The bobolink (fig. 9) is a common summer resident of the United States, north of about latitude 40°, and from New England westward to the Great Plains, wintering beyond our southern border. In New England there are few birds, if any, around which so much romance has clustered; in the South none on whose head so many maledictions have been heaped. The bobolink, entering the United States from the South at a time when the rice fields are freshly sown, pulls up the young plants and feeds upon the seed. Its stay, however, is not long, and it soon hastens northward, where it is welcomed as a herald of summer. During its sojourn in the Northern States it feeds mainly upon insects and small seeds of useless plants; but while rearing its young, insects constitute its chief food, and almost the exclusive diet of its brood. After the young are able to fly, the whole family gathers into a small flock and begins to live almost entirely upon vegetable food. This consists for the most part of weed seeds, since in the North these birds do not appear to molest grain to any great extent. They eat a few oats, but their stomachs do not reveal a great quantity of this or any other grain. As the season advances they gather into larger flocks and move southward, until by the end of August nearly all have left their breeding grounds. On their way they frequent the reedy marshes about the mouths of rivers and on the inland waters of the coast region, subsisting largely upon wild rice. After leaving the Northern States they are commonly known as reed birds, and having become very fat are treated as game.

They begin to arrive on the rice fields in the latter part of August, and during the next month make havoc in the ripening crop. It is unfortunate that the rice districts lie exactly in the track of their fall migration, since the abundant supply of food thus offered has undoubtedly served to attract them more and more, until most of the bobolinks bred in the North are concentrated with disastrous effect on the southeast coast when the rice ripens in the fall. There was evidently a time when no such supply of food awaited the birds on their journey southward, and it seems probable that the introduction of rice culture in the South, combined with the clearing of the forests in the North, thus affording a larger available breeding area, has favored an increase in the

FIG. 9.—Bobolink.

numbers of this species. The food habits of the bobolink are not necessarily inimical to the interests of agriculture. It simply happens that the rice affords a supply of food more easily obtainable than did the wild plants which formerly occupied the same region. Were the rice fields at a distance from the line of migration, or north of the bobolinks' breeding ground, they would probably never be molested; but lying, as they do, directly in the path of migration, they form a recruiting ground, where the birds can rest and accumulate flesh and strength for the long sea flight which awaits them in their course to South America.

The annual loss to rice growers on account of bobolinks has been estimated at $2,000,000. In the face of such losses it is evident that

no mere poetical sentiment should stand in the way of applying any remedy which can be devised. It would be unsafe to assume that the insects which the birds consume during their residence in the North can compensate for such destruction. If these figures are any approximation to the truth, the ordinary farmer will not believe that the bobolink benefits the Northern half of the country nearly as much as it damages the Southern half, and the thoughtful ornithologist will be inclined to agree with him. But even if the bird really does more harm than good, what is the remedy? For years the rice planters have been employing men and boys to shoot the birds and drive them away from the fields, but in spite of the millions slain every year their numbers do not decrease. In fact, a large part of the loss sustained is not in the grain which the birds actually eat, but in the outlay necessary to prevent them from taking it all. At present there seems to be no effective remedy short of complete extermination of the species, and this is evidently impracticable even were it desirable.

THE REDWINGED BLACKBIRD.

(*Agelaius phœniceus.*)

The redwinged, or swamp, blackbird (fig. 10) is found all over the United States and the region immediately to the north. While common in most of its range, its distribution is more or less local, mainly on account of its partiality for swamps. Its nest is built near standing water, in tall grass, rushes, or bushes. Owing to this peculiarity the bird may be absent from large tracts of country which afford no swamps or marshes suitable for nesting. It usually breeds in large colonies, though single families, consisting of a male with several wives, may sometimes be found in a small slough, where each of the females builds her nest and rears her own little brood, while her liege lord displays his brilliant colors and struts in the sunshine. In the Upper Mississippi Valley it finds the conditions most favorable, for the countless prairie sloughs and the margins of the numerous shallow lakes form nesting sites for thousands of redwings; and there are bred the immense flocks which sometimes do so much damage to the grain fields of the West. After the breeding season is over, the birds collect in flocks to migrate, and remain thus associated throughout the winter.

Many complaints have been made against the redwing, and several States have at times placed a bounty upon its head. It is said to cause great damage to grain in the West, especially in the Upper Mississippi Valley; and the rice growers of the South say that it eats rice. No complaints have been received from the Northeastern portion of the country, where the bird is much less abundant than in the West and South.

An examination of 725 stomachs showed that vegetable matter forms 74 per cent of the food, while the animal matter, mainly insects, forms

but 26 per cent. A little more than 10 per cent consists of beetles, mostly harmful species. Weevils, or snout beetles, amount to 4 per cent of the year's food, but in June reach 25 per cent. As weevils are among the most harmful insects known, their destruction should condone for at least some of the sins of which the bird has been accused. Grasshoppers constitute nearly 5 per cent of the food, while the rest of the animal matter is made up of various insects, a few snails, and crustaceans. Several dragon flies were found, but these were probably picked up dead, for they are too active to be taken alive, unless by one of the flycatchers. So far as the insect food as a whole is concerned, the redwing may be considered entirely beneficial.

The interest in the vegetable food of this bird centers around the

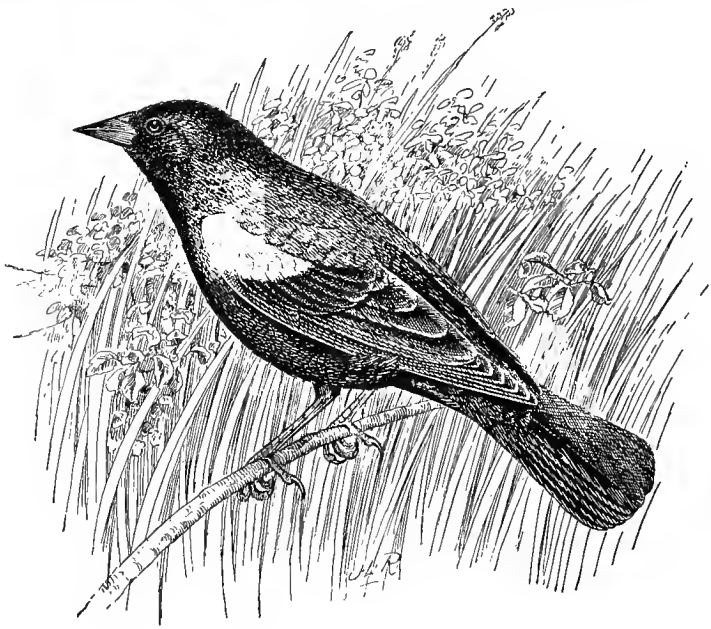


FIG. 10.—Redwinged blackbird.

grain. Only three kinds, corn, wheat, and oats, were found in appreciable quantities in the stomachs, and they aggregate but little more than 13 per cent of the whole food, oats forming nearly half of this amount. In view of the many complaints that the redwing eats grain, this record is surprisingly small. The crow blackbird has been found to eat more than three times as much. In the case of the crow, corn forms one-fifth of the food, so that the redwinged blackbird, whose diet is made up of only a trifle more than one-eighth of grain, is really one of the least destructive species; but the most important item of this bird's food is weed seed, which forms practically the whole food in winter and about 57 per cent of the whole year's fare. The principal weed seeds

eaten are those of ragweed, barn grass, smartweed, and about a dozen others. That these seeds are preferred is shown by the fact that the birds begin to eat them in August, when grain is still readily accessible, and continue feeding on them even after insects become plentiful in April. The redwing eats very little fruit and does practically no harm in the garden or orchard.

While it is impossible to dispute the mass of testimony which has accumulated concerning its grain-eating propensity, the stomach examinations show that the habit must be local rather than general. As the area of cultivation increases and the breeding grounds are curtailed, the species is likely to become reduced in numbers and consequently less harmful. Nearly seven-eighths of the redwing's food is made up of weed seed or of insects injurious to agriculture, indicating unmistakably that the bird should be protected, except, perhaps, in a few places where it is too abundant.

THE MEADOW LARK, OR OLD FIELD LARK.

(Sturnella magna.)

The meadow lark (fig. 11) is a common and well-known bird occurring from the Atlantic Coast to the Great Plains, where it gives way to a closely related subspecies, which extends thence westward to the Pacific. It winters from our southern border as far north as the District of Columbia, southern Illinois, and occasionally Iowa. Although it is a bird of the plains, finding its most congenial haunts in the prairies of the West, it does not disdain the meadows and mowing lands of New England. It nests on the ground and is so terrestrial in its habits that it seldom perches on trees, preferring a fence rail or a telegraph pole. When undisturbed, it may be seen walking about with a peculiar dainty step, stopping every few moments to look about and give its tail a nervous flirt or to sound a note or two of its clear whistle.

The meadow lark is almost wholly beneficial, although a few complaints have been made that it pulls sprouting grain, and one farmer claims that it eats clover seed. As a rule, however, it is looked upon with favor and is not disturbed.

In the 238 stomachs examined, animal food (practically all insects) constituted 73 per cent of the contents and vegetable matter 27 per cent. As would naturally be supposed, the insects were ground species, such as beetles, bugs, grasshoppers, and caterpillars, with a few flies, wasps, and spiders. A number of the stomachs were taken from birds that had been killed when the ground was covered with snow, but still they contained a large percentage of insects, showing the bird's skill in finding proper food under adverse circumstances.

Of the various insects eaten, crickets and grasshoppers are the most important, constituting 29 per cent of the entire year's food and 69 per cent of the food in August. It is scarcely necessary to enlarge upon

this point, but it can readily be seen what an effect a number of these birds must have on a field of grass in the height of the grasshopper season. Of the 238 stomachs collected at all seasons of the year, 178, or more than two-thirds, contained remains of grasshoppers, and one was filled with fragments of 37 of these insects. This seems to show conclusively that grasshoppers are preferred and are eaten whenever they can be procured. The great number taken in August is especially noticeable. This is essentially the grasshopper month, i. e., the month when grasshoppers reach their maximum abundance; and the stomach examination has shown that a large number of birds resort to this diet in August, no matter what may be the food during the rest of the year.

Next to grasshoppers, beetles make up the most important item of the meadow lark's food, amounting to nearly 21 per cent, of which about one-third are predaceous ground beetles. The others are all harmful

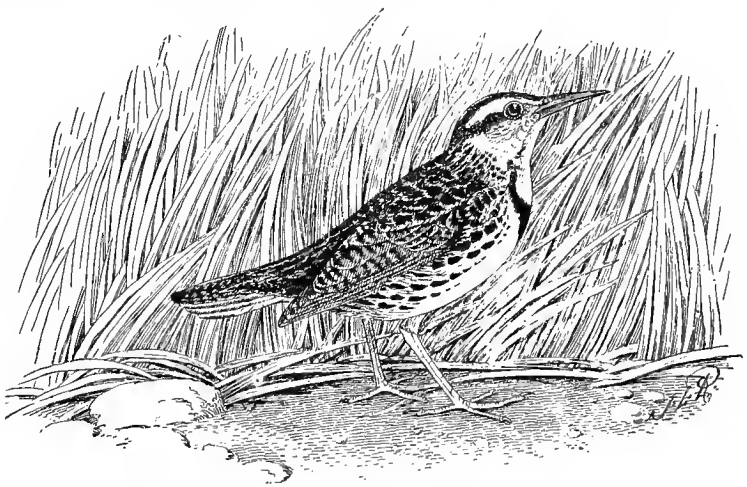


FIG. 11.—Meadow lark.

species, and when it is considered that the bird feeds exclusively on the ground, it seems remarkable that so few useful ground beetles are eaten. Many of them have a disgusting odor, and possibly this may occasionally save them from destruction by birds, especially when other food is abundant. Caterpillars, too, form a very constant element, and in May constitute over 28 per cent of the whole food. May is the month when the dreaded cutworm begins its deadly career, and then the bird does some of its best work. Most of these caterpillars are ground feeders, and are overlooked by birds which habitually frequent trees; but the meadow lark finds them and devours them by thousands. The remainder of the insect food is made up of a few ants, wasps, and spiders, with a few bugs, including some chinch bugs.

The vegetable food consists of grain, weed, and other hard seeds. Grain in general amounts to 14, and weed and other seeds to 12 per cent.

The grain, principally corn, is mostly eaten in winter and early spring, and must be therefore simply waste kernels; only a trifle is consumed in summer and autumn, when it is most plentiful. No trace of sprouting grain was discovered. Clover seed was found in only six stomachs, and but little in each. Seeds of weeds, principally ragweed, barn grass, and smartweed, are eaten from November to April, inclusive, but during the rest of the year are replaced by insects.

Briefly stated, more than half of the meadow lark's food consists of harmful insects; its vegetable food is composed either of noxious weeds or waste grain, and the remainder is made up of useful beetles or neutral insects and spiders. A strong point in the bird's favor is that, although naturally an insect eater, it is able to subsist on vegetable food, and consequently is not forced to migrate in cold weather any farther than is necessary to find ground free from snow. This explains why it remains for the most part in the United States during winter, and moves northward as soon as the snow disappears from its usual haunts.

There is one danger to which the meadow lark is exposed. As its flesh is highly esteemed the bird is often shot for the table, but it is entitled to all possible protection, and to slaughter it for game is the least profitable way to utilize a valuable species.

THE BALTIMORE ORIOLE.

(*Icterus galbula.*)

Brilliancy of plumage, sweetness of song, and food habits to which no exception can be taken are some of the striking characteristics of the Baltimore oriole (fig. 12). In summer this species is found throughout the northern half of the United States east of the Great Plains, and is welcomed and loved in every country home in that broad land. In the Northern States it arrives rather late, and is usually first seen, or heard, foraging amidst the early bloom of the apple trees, where it searches for caterpillars or feeds daintily on the surplus blossoms. Its nest commands hardly less admiration than the beauty of its plumage or the excellence of its song. Hanging from the tip of the outermost bough of a stately elm, it is almost inaccessible, and so strongly fastened as to bid defiance to the elements.

By watching an oriole which has a nest one may see it searching among the smaller branches of some neighboring tree, carefully examining each leaf for caterpillars, and occasionally trilling a few notes to its mate. Observation both in the field and laboratory shows that caterpillars constitute the largest item of its fare. In 113 stomachs they formed 34 per cent of the food, and are eaten in varying quantities during all the months in which the bird remains in this country, although the fewest are eaten in July, when a little fruit is also taken. The other insects consist of beetles, bugs, ants, wasps, grasshoppers, and some spiders. The beetles are principally click beetles, the larvæ of which are among the most destructive insects known; and the bugs

include plant and bark lice, both very harmful, but so small and obscure as to be passed over unnoticed by most birds. Ants are eaten mostly in spring, grasshoppers in July and August, and wasps and spiders with considerable regularity throughout the season.

Vegetable matter amounts to only a little more than 16 per cent of the food during the bird's stay in the United States, so that the possibility of the oriole doing much damage to crops is very limited. The bird has been accused of eating peas to a considerable extent, but remains of peas were found in only two stomachs. One writer says that it damages grapes, but none were found. In fact, a few blackberries and

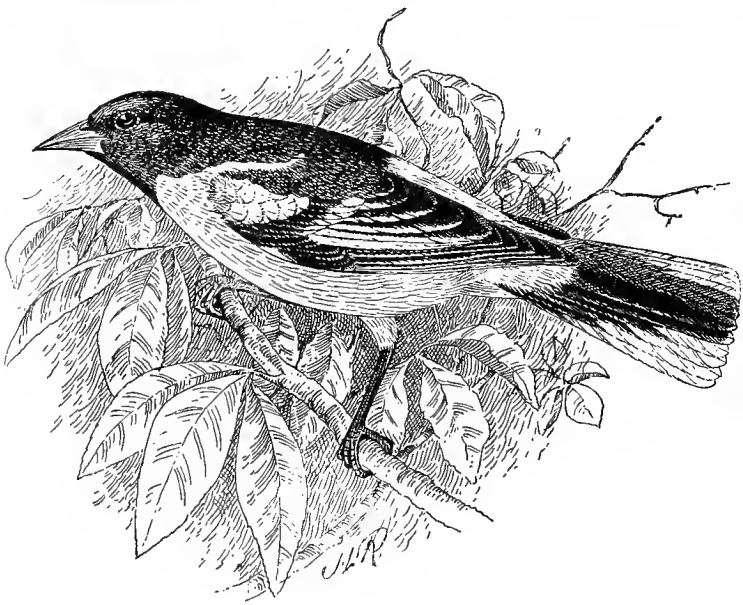


FIG. 12.—Baltimore oriole.

cherries comprised the only cultivated fruit detected in the stomachs, the remainder of the vegetable food being wild fruit and a few miscellaneous seeds.

THE CROW BLACKBIRD, OR GRACKLE.

(*Quiscalus quiscula.*)

The crow blackbird (fig. 13) or one of its subspecies is a familiar object in all of the States east of the Rocky Mountains. It is a resident throughout the year as far north as southern Illinois, and in summer extends its range into British America. In the Mississippi Valley it is one of the most abundant birds, preferring to nest in the artificial groves and windbreaks near farms instead of the natural "timber" which it formerly used. It breeds also in parks and near buildings, often in considerable colonies. Farther east, in New England, it is only locally abundant, though frequently seen in migration. After July it

becomes very rare, or entirely disappears, owing to the fact that it collects in large flocks and retires to some quiet place, where food is abundant and where it can remain undisturbed during the molting season, but in the latter days of August and throughout September it usually reappears in immense numbers before moving southward.

It is evident that a bird so large and so abundant may exercise an important influence upon the agricultural welfare of the country it inhabits. The crow blackbird has been accused of many sins, such as stealing grain and fruit and robbing the nests of other birds; but the farmers do not undertake any war of extermination against it, and, for the most part, allow it to nest about the premises undisturbed. An examination of 2,258 stomachs showed that nearly one-third of its food consists of insects, of which the greater part are injurious. The bird

FIG. 13.—Crow blackbird.

also eats a few snails, crayfishes, salamanders, small fish, and occasionally a mouse. The stomach contents do not indicate that it robs other birds' nests to any great extent, as remains of birds and birds' eggs amount to less than one-half of 1 per cent.

It is, however, on account of its vegetable food that the grackle is most likely to be accused of doing damage. Grain is eaten during the whole year, and during only a short time in summer is other food attractive enough to induce the bird to alter its diet. The grain taken in the winter and spring months probably consists of waste kernels gathered from the stubble. The stomachs do not indicate that the bird pulls sprouting grain; but the wheat eaten in July and August, and the corn eaten in the fall, are probably taken from fields of standing

grain. The total grain consumed during the year constitutes 45 per cent of the whole food, but it is safe to say that at least half is waste grain, and consequently of no value. Although the crow blackbird eats a few cherries and blackberries in their season, and some wild fruit in the fall, it apparently does no damage in this way.

Large flocks of crow blackbirds no doubt do considerable injury to grain crops, and there seems to be no remedy except the destruction of the birds, which is in itself expensive. During the breeding season, however, the species does much good by eating insects and by feeding them to its young, which are reared almost entirely upon this food. The bird does the greatest amount of good in spring, when it follows the plow in search of large grub worms, of which it is so fond that it sometimes literally crams its stomach full of them. The farmer must decide for himself whether or not these birds cause more damage than can be repaid by insect destruction; but when they destroy an entire crop it is no consolation to know that they have already eaten a multitude of insects which, if left alone, would have accomplished the same result.

THE SPARROWS.[1]

Sparrows are not obtrusive birds, either in plumage, song, or action. There are some forty species, with nearly as many subspecies, in North America, but their differences, both in plumage and habits, are in most cases too obscure to be readily recognized, and not more than half a dozen forms are generally known in any one locality. All the species are more or less migratory, but so widely are they distributed that there is probably no part of the country where some can not be found throughout the year.

While sparrows are noted seed eaters, they do not by any means confine themselves to a vegetable diet. During the summer, and especially in the breeding season, they eat many insects, and probably feed their young largely upon the same food. An examination of the stomachs of three species—the song sparrow (*Melospiza*), chipping sparrow (*Spizella socialis*), and field sparrow (*Spizella pusilla*) (fig. 14)—shows that about one-third of the food consists of insects, comprising many injurious beetles, such as snout-beetles or weevils, and leaf-beetles. Many grasshoppers are eaten, and in the case of the chipping sparrow these insects form one-eighth of the food. Grasshoppers would seem to be rather large morsels, but the bird probably confines itself to the smaller species; indeed, this is indicated by the fact that the greatest amount (over 36 per cent) is eaten in June, when the larger species are still young and the small species most numerous. Besides the insects already mentioned, many wasps and bugs are taken. Predaceous and parasitic Hymenoptera and predaceous beetles, all useful insects, are

[1]The sparrows here mentioned are all native species. For a full account of the English sparrow, including its introduction, habits, and depredations, see Bull. No. 1 of the Division of Ornithology, published in 1889.

eaten only to a slight extent, so that as a whole the sparrows' insect diet may be considered beneficial.

Their vegetable food is limited almost exclusively to hard seeds This might seem to indicate that the birds feed to some extent upon grain, but the stomachs examined show only one kind—oats—and but little of that. The great bulk of the food is made up of grass and weed seed, which form almost the entire diet during winter, and the amount consumed is immense.

Anyone acquainted with the agricultural region of the Upper Mississippi Valley can not have failed to notice the enormous growth of weeds in every waste spot where the original sward has been disturbed.

FIG. 14.—Field sparrow.

By the roadside, on the borders of cultivated fields, or in abandoned fields, wherever they can obtain a foothold, masses of rank weeds spring up, and often form impenetrable thickets which afford food and shelter for immense numbers of birds and enable them to withstand great cold and the most terrible blizzards. A person visiting one of these weed patches on a sunny morning in January, when the thermometer is 20° or more below zero, will be struck with the life and animation of the busy little inhabitants. Instead of sitting forlorn and half frozen, they may be seen flitting from branch to branch, twittering and fluttering, and showing every evidence of enjoyment and perfect comfort. If one

of them be killed and examined, it will be found in excellent condition—in fact, a veritable ball of fat.

The snowbird (*Junco hyemalis*) and tree sparrow (*Spizella monticola*) are perhaps the most numerous of all the sparrows. The latter fairly swarms all over the Northern States in winter, arriving from the north early in October and leaving in April. Examination of many stomachs shows that in winter the tree sparrow feeds entirely upon seeds of weeds; and probably each bird consumes about one-fourth of an ounce a day. In an article contributed to the New York Tribune in 1881 the writer estimated the amount of weed seed annually destroyed by these birds in the State of Iowa. Upon the basis of one-fourth of an ounce of seed eaten daily by each bird, and supposing that the birds averaged ten to each square mile, and that they remain in their winter range two hundred days, we shall have a total of 1,750,000 pounds, or 875 tons, of weed seed consumed by this one species in a single season. Large as these figures may seem, they certainly fall far short of the reality. The estimate of ten birds to a square mile is much within the truth, for the tree sparrow is certainly more abundant than this in winter in Massachusetts, where the food supply is less than in the Western States, and I have known places in Iowa where several thousand could be seen within the space of a few acres. This estimate, moreover, is for a single species, while, as a matter of fact, there are at least half a dozen birds (not all sparrows) that habitually feed on these seeds during winter.

Farther south the tree sparrow is replaced in winter by the white-throated sparrow, the white-crowned sparrow, the fox sparrow, the song sparrow, the field sparrow, and several others; so that all over the country there are a vast number of these seed eaters at work during the colder months reducing next year's crop of worse than useless plants.

In treating of the value of birds, it has been customary to consider them mainly as insect destroyers; but the foregoing illustration seems to show that seed eaters have a useful function, which has never been fully appreciated.

THE ROSE-BREASTED GROSBEAK.

(*Zamelodia ludoviciana.*)

The beautiful rose-breasted grosbeak (fig. 15) breeds in the northern half of the United States east of the Missouri River, but spends its winters beyond our boundaries. Unfortunately it is not abundant in New England, and nowhere as plentiful as it should be. It frequents groves and orchards rather than gardens or dooryards, but probably the beauty of the male is the greatest obstacle to its increase; the fully adult bird is pure black and white, with a broad patch of brilliant rose color upon the breast and under each wing. On account of this

attractive plumage the birds are highly prized for ladies' hats; and consequently have been shot in season and out, till the wonder is not that there are so few, but that any remain at all.

When the Colorado potato beetle first swept over the land, and naturalists and farmers were anxious to discover whether or not there were any enemies which would prey upon the pest, the grosbeak was almost the only bird seen to eat the beetles. Further observation confirmed the fact, and there can be no reasonable doubt that where the bird is abundant it has contributed very much to the abatement of the pest which has been noted during the last decade. But this is not the only good which the bird does, for many other noxious insects besides the potato beetle are also eaten.

The vegetable food of the grosbeak consists of buds and blossoms of forest trees, and seeds, but the only damage of which it has been

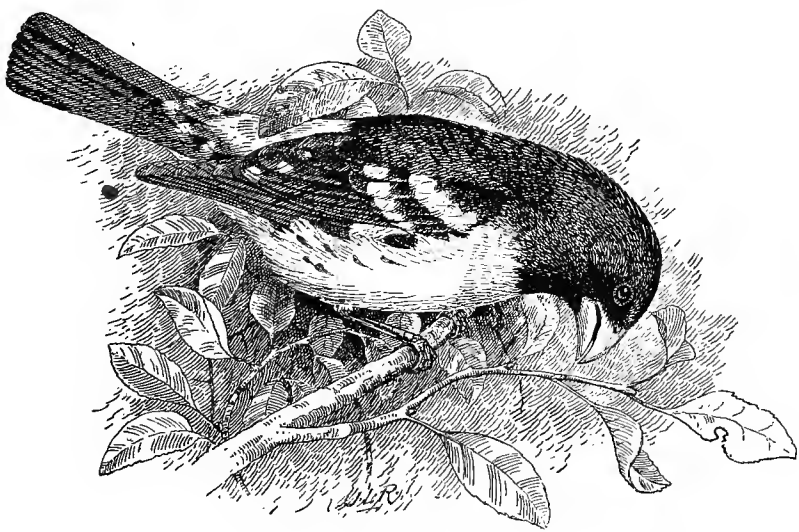


FIG. 15.—Rose-breasted grosbeak.

accused is the stealing of green peas. The writer has observed it eating peas and has examined the stomachs of several that had been killed in the very act. The stomachs contained a few peas and enough potato beetles, old and young, as well as other harmful insects, to pay for all the peas the birds would be likely to eat in a whole season. The garden where this took place adjoined a small potato field which earlier in the season had been so badly infested with the beetles that the vines were completely riddled. The grosbeaks visited the field every day, and finally brought their fledged young. The young birds stood in a row on the topmost rail of the fence and were fed with the beetles which their parents gathered. When a careful inspection was made a few days later, not a beetle, old or young, could be found; the birds had swept them from the field and saved the potatoes.

It is not easy to advise measures either for increasing the numbers of this bird or inducing it to take up its residence on the farm. Naturally it inhabits thin, open woods or groves, and the change from such places to orchards would be simple—in fact, has already been made in some parts of Pennsylvania and Ohio. In New England the bird is somewhat rare, and perhaps the best that can be done here or elsewhere is to see that it is thoroughly protected.

THE SWALLOWS.

There are seven common species of swallows within the limits of the United States, four of which have, to some extent, abandoned their

FIG. 16.—Barn swallow.

primitive nesting habits and attached themselves to the abodes of man. As a group, swallows are gregarious and social in an eminent degree. Some species build nests in large colonies, occasionally numbering thousands; in the case of others only two or three pairs are found together; while still others nest habitually in single pairs.

Their habits are too familiar to require any extended description. Their industry and tirelessness are wonderful, and during the day it is rare to see swallows at rest except just before their departure for the South, when they assemble upon telegraph wires or upon the roofs of buildings, apparently making plans for the journey.

A noticeable characteristic of several of the species is their attachment to man. In the eastern part of the country the barn swallow (*Chelidon erythrogastra*) (fig. 16) now builds exclusively under roofs, having entirely abandoned the rock caves and cliffs in which it formerly nested. More recently the cliff swallow (*Petrochelidon lunifrons*) has found a better nesting site under the eaves of buildings than was afforded by the overhanging cliffs of earth or stone which it once used, and to which it still resorts occasionally in the East, and habitually in the unsettled West. The martin (*Progne subis*) and white-bellied swallow (*Tachycineta bicolor*) nest either in houses supplied for the purpose, in abandoned nests of woodpeckers, or in natural crannies in rocks. The other species have not yet abandoned their primitive habitats, but possibly may do so as the country becomes more thickly settled.

Field observation will convince any ordinarily attentive person that the food of swallows must consist of the smaller insects captured in mid-air, or perhaps in some cases picked from the tops of tall grass or weeds. This observation is borne out by an examination of stomachs, which shows that the food consists of many small species of beetles which are much on the wing; many species of Diptera (mosquitoes and their allies), with large quantities of flying ants and a few insects of similar kinds. Most of them are either injurious or annoying, and the numbers destroyed by swallows are not only beyond calculation, but almost beyond imagination.

The white-bellied swallow eats a considerable number of berries of the bayberry, or wax myrtle. During migrations and in winter it has a habit of roosting in these shrubs, and it probably obtains the fruit at that time.

It is a mistake to tear down the nests of a colony of cliff swallows from the eaves of a barn, for so far from disfiguring a building the nests make a picturesque addition, and their presence should be encouraged by every device. It is said that cliff and barn swallows can be induced to build their nests in a particular locality, otherwise suitable, by providing a quantity of mud to be used as mortar. Barn swallows may also be encouraged by cutting a small hole in the gable of the barn, while martins and white-bellied swallows will be grateful for boxes like those for the bluebird, but placed in some higher situation.

THE CEDAR BIRD.

(*Ampelis cedrorum.*)

The cedar waxwing, or cherry bird (fig. 17), inhabits the whole of the United States, but is much less common in the West. Although the great bulk of the species retires southward in winter, the bird is occasionally found in every State during the colder months, especially if wild berries are abundant. Its proverbial fondness for cherries has given rise to its popular name, and much complaint has been made on account of the fruit eaten. Observation has shown, however, that its

depredations are confined to trees on which the fruit ripens earliest, while later varieties are comparatively untouched. This is probably owing to the fact that when wild fruits ripen they are preferred to cherries, and really constitute the bulk of the cedar bird's diet.

In 152 stomachs examined animal matter formed only 13 and vegetable 87 per cent, showing that the bird is not wholly a fruit eater. With the exception of a few snails, all the animal food consisted of insects, mainly beetles—and all but one more or less noxious, the famous elm leaf-beetle being among the number. Bark or scale lice were found in several stomachs, while the remainder of the animal food was made up of grasshoppers, bugs, and the like. Three nestlings were found to have been fed almost entirely on insects.

Of the 87 per cent of vegetable food, 74 consisted entirely of wild fruit or seeds and 13 of cultivated fruit, but a large part of the latter

FIG. 17.—Cedar bird.

was made up of blackberries and raspberries, and it is very doubtful whether they represented cultivated varieties. Cherry stealing is the chief complaint against this bird, but of the 152 stomachs only 9, all taken in June and July, contained any remains of cultivated cherries, and these aggregate but 5 per cent of the year's food. As 41 stomachs were collected in those months, it is evident that the birds do not live to any great extent on cultivated cherries.

Although the cherry bird is not a great insect destroyer, it does some good work in this way, since it probably rears its young mostly upon insect food. On the other hand, it does not devour nearly as much cultivated fruit as has been asserted, and most, if not all, of the damage can be prevented. The bird should therefore be considered a useful species, and as such should be accorded all possible protection.

THE CATBIRD.

(*Galeoscoptes carolinensis.*)

The catbird (fig. 18), like the thrasher, is a lover of swamps, and delights to make its home in a tangle of wild grapevines, greenbriers, and shrubs, where it is safe from attack and can find its favorite food in abundance. It is found throughout the United States west to the Rocky Mountains; occurs also in Washington, Idaho, and Utah, and extends northward into British America. It winters in the Southern States, Cuba, Mexico, and Central America.

The catbird always attracts attention, and the intruder upon its haunts soon understands that he is not welcome. There is no mistaking the meaning of the sneering voice with which he is saluted, and there is little doubt that this gave rise to the popular prejudice against the

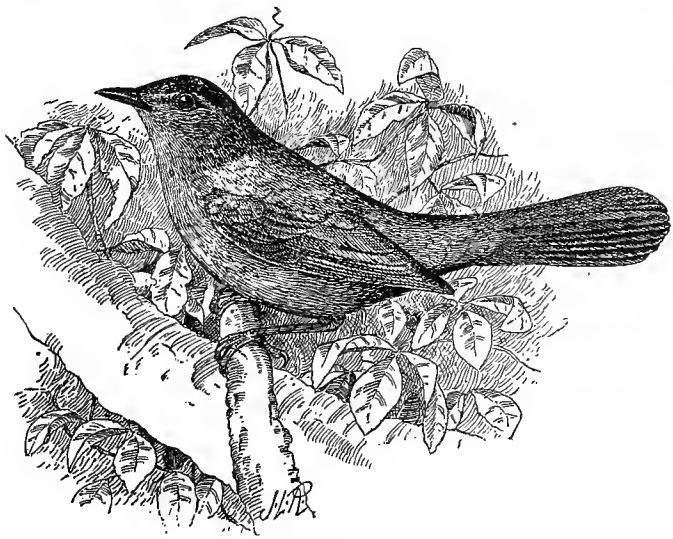


FIG. 18.—Catbird.

bird; but the feeling has been increased by the fact that the species is sometimes a serious annoyance to fruit growers. All such reports, however, seem to come from the prairie country of the West. In New England, according to the writer's experience the catbird is seldom seen about gardens or orchards; the reason may possibly be found in the fact that on the prairies fruit-bearing shrubs which afford so large a part of this bird's food are conspicuously absent. With the settlement of this region comes an extensive planting of orchards, vineyards, and small fruit gardens, which furnish shelter and nesting sites for the catbird, as well as for other species, with a consequent large increase in their numbers, but without providing the native fruits upon which they have been accustomed to feed. Under these circumstances, what is more natural than for the birds to turn to cultivated fruits for their

supplies? The remedy is obvious; cultivated fruits can be protected by the simple expedient of planting wild species or others which are preferred by the birds. Some experiments with catbirds in captivity showed that the Russian mulberry was preferred to any cultivated fruit that could be offered.

The stomachs of 213 catbirds were examined and found to contain 44 per cent of animal (insect) and 56 per cent of vegetable food.[1] Ants, beetles, caterpillars, and grasshoppers constitute three-fourths of the animal food, the remainder being made up of bugs, miscellaneous insects and spiders. One-third of the vegetable food consists of cultivated fruits, or those which may be cultivated, such as strawberries, raspberries, and blackberries; but while we debit the bird with the whole of this, it is probable—and in the eastern and well-wooded part of the country almost certain—that a large part was obtained from wild vines. The rest of the vegetable matter is mostly wild fruit, such as cherries, dogwood, sour gum, elder berries, greenbrier, spice berries, black alder, sumac, and poison ivy.

Although the catbird sometimes does considerable harm by destroying small fruit, the bird can not be considered injurious. On the contrary, in most parts of the country it does far more good than harm, and the evil it does can be reduced appreciably by the methods already pointed out.

THE BROWN THRASHER.

(*Harporhynchus rufus.*)

The brown thrasher (fig. 19) breeds throughout the United States east of the Great Plains, and winters in the south Atlantic and Gulf States. It occasionally visits the garden or orchard, but nests in swamps or in groves standing upon low ground. While it generally prefers a thickly grown retreat, it sometimes builds in a pile of brush at a distance from trees. On account of its more retiring habits it is not so conspicuous as the robin, although it may be equally abundant. Few birds can excel the thrasher in sweetness of song, but it is so shy that its notes are not heard often enough to be appreciated. Its favorite time for singing is the early morning, when, perched on the top of some tall bush or low tree, it gives an exhibition of vocal powers which would do credit to a mockingbird. Indeed, in the South, where the latter bird is abundant, the thrasher is known as the sandy mocker.

The food of the brown thrasher consists of both fruit and insects. An examination of 121 stomachs showed 36 per cent of vegetable and 64 of animal food, practically all insects, and mostly taken in spring before fruit is ripe. Half the insects were beetles, and the remainder chiefly grasshoppers, caterpillars, bugs, and spiders. A few predaceous

[1] The investigation of the food of the catbird, brown thrasher, and house wren was made by Mr. Sylvester D. Judd and published in the Yearbook of the Department of Agriculture for 1895, pp. 405-408.

beetles were eaten, but, on the whole, its work as an insect destroyer may be considered beneficial.

Eight per cent of the food is made up of fruits like raspberries and currants which are or may be cultivated, but the raspberries at least are as likely to belong to wild as to cultivated varieties. Grain, made up mostly of scattered kernels of oats and corn, is merely a trifle, amounting to only 3 per cent, and though some of the corn may be taken from newly planted fields it is amply paid for by the May beetles which are eaten at the same time. The rest of the food consists of wild fruit or seeds. Taken all in all, the brown thrasher is a useful bird, and probably does just as good work in its secluded retreats as

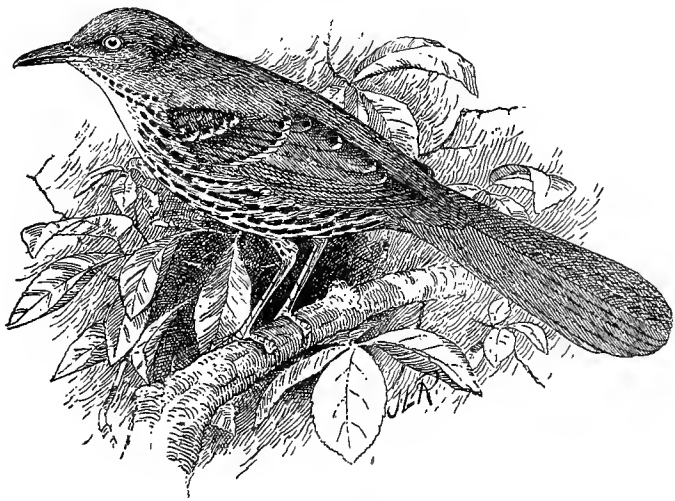


FIG. 19.—Brown thrasher.

it would about the garden, for the swamps and groves are no doubt the breeding grounds of many insects that migrate thence to attack the farmers' crops.

THE HOUSE WREN.

(*Troglodytes aëdon.*)

The diminutive house wren (fig. 20) frequents barns and gardens, and particularly old orchards in which the trees are partially decayed. He makes his nest in a hollow branch where perhaps a woodpecker had a domicile the year before, but he is a pugnacious character, and if he happens to fancy one of the boxes that have been put up for the bluebirds he does not hesitate to take it. He is usually received with favor, and is not slow to avail himself of boxes, gourds, tin cans, or empty jars placed for his accommodation.

As regards food habits, the house wren is entirely beneficial. Practically, he can be said to live upon animal food alone, for an examination

of 52 stomachs showed that 98 per cent of the stomach contents was made up of insects or their allies, and only 2 per cent was vegetable, including bits of grass and similar matter, evidently taken by accident with the insects. Half of this food consisted of grasshoppers and beetles; the remainder of caterpillars, bugs, and spiders. As the house wren is a prolific breeder, frequently rearing from twelve to sixteen young in a season, a family of these birds must cause considerable reduction in the number of insects in a garden. Wrens are industrious foragers, searching every tree, shrub, or vine for caterpillars, examining every post and rail of the fence, and every cranny in the wall for insects or spiders. They do not, as a rule, fly far afield, but work

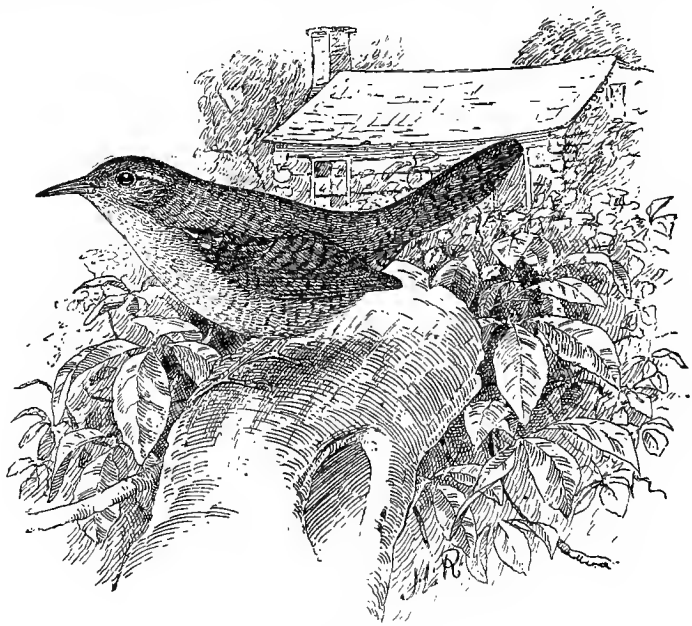


FIG. 20.—House wren.

industriously in the immediate vicinity of their nests. In this way they become valuable aids in the garden or orchard, and by providing suitable nesting boxes they may be induced to take up residence where their services will do most good. Their eccentricities in the selection of a home are well known. Almost anything, from an old cigar box to a tomato can, an old teapot, a worn-out boot, or a horse's skull, is acceptable, provided it be placed well up from the ground and out of reach of cats and other prowlers.

It does not seem possible to have too many wrens, and every effort should be made to protect them and to encourage their nesting about the house.

THE ROBIN.

(*Merula migratoria.*)

The robin (fig. 21) is found throughout the United States east of the Great Plains, and is represented farther west by a slightly different subspecies. It extends far north through Canada, and is found even in Alaska. Although the great bulk of the species leaves the Northern States in winter, a few individuals remain in sheltered swamps, where wild berries furnish an abundant supply of food.

The robin builds its nest in orchards and gardens, and occasionally takes advantage of a nook about the house, or under the shelter of the roof of a shed or outbuilding. Its food habits have sometimes caused apprehension to the fruit grower, for it is fond of cherries and other small fruits, particularly the earlier varieties. For this reason many complaints have been lodged against it, and some persons have gone

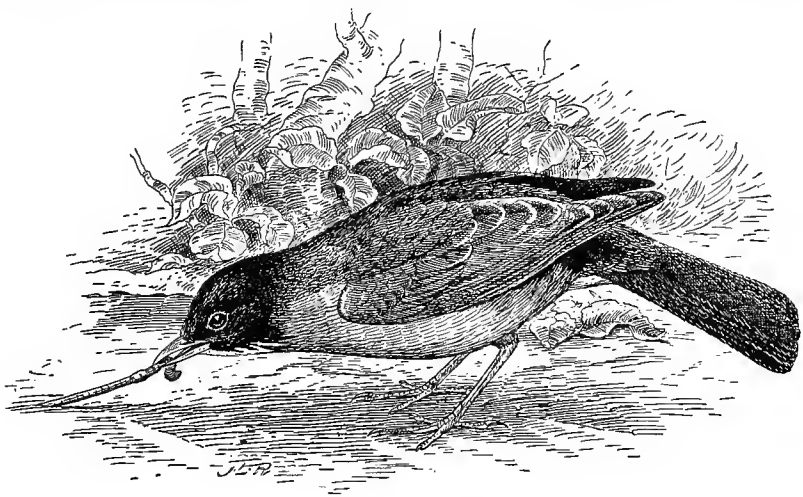


FIG. 21.—Robin.

so far as to condemn the bird. The robin is, however, too valuable to be exterminated, and choice fruit can be readily protected from its depredations.

An examination of 330 stomachs shows that over 42 per cent of its food is animal matter, principally insects, while the remainder is made up largely of small fruits or berries. Over 19 per cent consists of beetles, about one-third of which are useful ground beetles, taken mostly in spring and fall, when other insects are scarce. Grasshoppers make up about one-tenth of the whole food, but in August comprise over 30 per cent. Caterpillars form about 6 per cent, while the rest of the animal food, about 7 per cent, is made up of various insects, with a few spiders, snails, and angle-worms. All the grasshoppers, caterpillars, and bugs, with a large portion of the beetles, are injurious, and it is safe to say that noxious insects comprise more than one-third of the robin's food.

Vegetable food forms nearly 58 per cent of the stomach contents, over 47 being wild fruits, and only a little more than 4 per cent being possibly cultivated varieties. Cultivated fruit amounting to about 25 per cent was found in the stomachs in June and July, but only a trifle in August. Wild fruit, on the contrary, is eaten in every month, and constitutes a staple food during half the year. No less than forty-one species were identified in the stomachs; of these, the most important were four species of dogwood, three of wild cherries, three of wild grapes, four of greenbrier, two of holly, two of elder; and cranberries, huckleberries, blueberries, barberries, service berries, hackberries, and persimmons, with four species of sumac, and various other seeds not strictly fruit.

The depredations of the robin seem to be confined to the smaller and earlier fruits, and few, if any, complaints have been made against it on the score of eating apples, peaches, pears, grapes, or even late cherries. By the time these are ripe the forests and hedges are teeming with wild fruits, which the bird evidently finds more to its taste. The cherry, unfortunately, ripens so early that it is almost the only fruit accessible at a time when the bird's appetite has been sharpened by a long-continued diet of insects, earthworms, and dried berries, and it is no wonder that at first the rich juicy morsels are greedily eaten. In view of the fact that the robin takes ten times as much wild as cultivated fruit, it seems unwise to destroy the birds to save so little. Nor is this necessary, for by a little care both may be preserved. Where much fruit is grown, it is no great loss to give up one tree to the birds; and in some cases the crop can be protected by scarecrows. Where wild fruit is not abundant, a few fruit-bearing shrubs and vines judiciously planted will serve for ornament and provide food for the birds. The Russian mulberry is a vigorous grower and a profuse bearer, ripening at the same time as the cherry, and, so far as observation has gone, most birds seem to prefer its fruit to any other. It is believed that a number of these trees planted around the garden or orchard would fully protect the more valuable fruits.

Many persons have written about the delicate discrimination of birds for choice fruit, asserting that only the finest and costliest varieties are selected. This is contrary to all careful scientific observation. Birds, unlike human beings, seem to prefer fruit like the mulberry, that is sweetly insipid, or that has some astringent or bitter quality like the chokecherry or holly. The so-called black alder (*Ilex verticillata*), which is a species of holly, has bright scarlet berries, as bitter as quinine, that ripen late in October, and remain on the bushes through November, and though frost grapes, the fruit of the Virginia creeper, and several species of dogwood are abundant at the same time, the birds eat the berries of the holly to a considerable extent, as shown by the seeds found in the stomachs. It is moreover a remarkable fact that the wild fruits upon which the birds feed largely are those which man neither gathers for his own use nor adopts for cultivation.

THE BLUEBIRD.

(*Sialia sialis.*)

The common and familiar bluebird (fig. 22) is an inhabitant of all the States east of the Rocky Mountains from the Gulf of Mexico northward into Canada. It winters as far north as southern Illinois, in the Mississippi Valley, and Pennsylvania in the east; in spring it is one of the first migrants to arrive in the Northern States, and is always welcomed as an indication of the final breaking up of winter. It frequents orchards and gardens, where it builds its nest in hollow trees, or takes advantage of a nesting box provided by the enterprising farmer's boy.

So far as known, this bird has not been accused of stealing fruit or of preying upon any crops. An examination of 205 stomachs showed

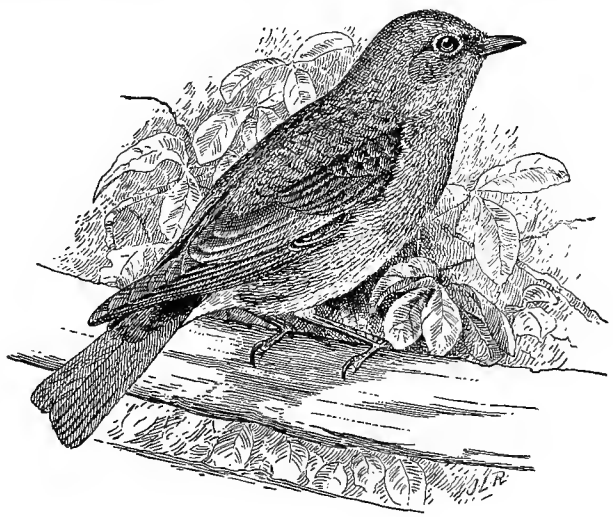


FIG. 22.—Bluebird.

that 76 per cent of the food consists of insects and their allies, while the other 24 per cent is made up of various vegetable substances, found mostly in stomachs taken in winter. Beetles constitute 28 per cent of the whole food, grasshoppers 22, caterpillars 11, and various insects, including quite a number of spiders, comprise the remainder of the insect diet. All these are more or less harmful, except a few predaceous beetles, which amount to 8 per cent, but in view of the large consumption of grasshoppers and caterpillars, we can at least condone this offense, if such it may be called. The destruction of grasshoppers is very noticeable in the months of August and September, when these insects form more than 60 per cent of the diet.

It is evident that in the selection of its food the bluebird is governed more by abundance than by choice. Predaceous beetles are eaten in

spring, as they are among the first insects to appear; but in early summer caterpillars form an important part of the diet, and are replaced a little later by grasshoppers. Beetles are eaten at all times, except when grasshoppers are more easily obtained.

So far as its vegetable food is concerned, the bluebird is positively harmless. The only trace of any useful product in the stomachs consisted of a few blackberry seeds, and even these more probably belonged to wild than cultivated varieties. Following is a list of the various seeds which were found: Blackberry, chokeberry, juniperberry, poke, berry, partridgeberry, greenbriar, Virginia creeper, bittersweet, hollystrawberry bush, false spikenard, wild sarsaparilla, sumac (several species), rose haws, sorrel, ragweed, grass, and asparagus. This list shows how little the bluebird depends upon the farm or garden to supply its needs, and indicates that by encouraging the growth of some of these plants, many of which are highly ornamental, the bird can be induced to make its home on the premises.

Bluebirds are so well known that it seems unnecessary to urge anything more in their favor; but in view of the fact that large numbers were destroyed during the severe storm of 1895, more than ordinary vigilance should be exercised in protecting them until they have regained their normal abundance.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 54.

SOME COMMON BIRDS

IN THEIR RELATION TO AGRICULTURE.

BY

F. E. L. BEAL, B. S.,
ASSISTANT ORNITHOLOGIST, BIOLOGICAL SURVEY.

[May, 1897.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

CONTENTS.

SOME COMMON BIRDS IN THEIR RELATION TO AGRICULTURE.

INTRODUCTION.

It has long been known that birds play an important part in relation to agriculture, but there seems to be a tendency to dwell on the harm they do rather than on the good. Whether a bird is injurious or beneficial depends almost entirely upon what it eats, and in the case of species which are unusually abundant or which depend in part upon the farmer's crops for subsistence the character of the food often becomes a very practical question. If crows or blackbirds are seen in numbers about cornfields, or if woodpeckers are noticed at work in an orchard, it is perhaps not surprising that they are accused of doing harm. Careful investigation, however, often shows that they are actually destroying noxious insects, and also that even those which do harm at one season may compensate for it by eating noxious species at another. Insects are eaten at all times by the majority of land birds, and during the breeding season most kinds subsist largely and rear their young exclusively on this food. When insects are unusually plentiful, they are eaten by many birds which ordinarily do not touch them. Even birds of prey resort to this diet, and when insects are more easily obtained than other fare, the smaller hawks and owls live on them almost entirely. This was well illustrated during the recent plague of Rocky Mountain locusts in the Western States, when it was found that locusts were eaten by nearly every bird in the region, and that they formed almost the entire food of a large majority of the species.

Within certain limits, birds feed upon the kind of food that is most accessible. Thus, as a rule, insectivorous birds eat the insects that are most easily obtained, provided they do not have some peculiarly disagreeable property. It is not probable that a bird habitually passes by one kind of insect to look for another which is more appetizing, and there seems little evidence in support of the theory that the selection of food is restricted to any particular species of insect, for it is evident that a bird eats those which by its own method of seeking are most easily obtained. Thus, a ground-feeding bird eats those it finds among the dead leaves and grass; a flycatcher, watching for its prey from some vantage point, captures entirely different kinds; and the

woodpecker and warbler, in the tree tops, select still others. It is thus apparent that a bird's diet is likely to be quite varied, and to differ at different seasons of the year.

In investigating the food habits of birds, field observation can be relied on only to a limited extent, for it is not always easy to determine what a bird really eats by watching it. In order to be positive on this point, it is necessary to examine the stomach contents. When birds are suspected of doing injury to field crops or fruit trees, a few individuals should be shot and their stomachs examined. This will show unmistakably whether or not the birds are guilty.

In response to a general demand for definite information regarding the food habits of our native birds, the Biological Survey of the Department of Agriculture has for some years past been conducting a systematic investigation of the food of species which are believed to be of economic importance. Thousands of birds' stomachs have been carefully examined in the laboratory, and all the available data respecting the food brought together. The results of the investigations relating to birds of prey, based on an examination of nearly 3,000 stomachs, were published in 1893, in a special bulletin entitled The Hawks and Owls of the United States. Many other species have been similarly studied and the results published, either in special bulletins or as articles in the yearbooks. The present bulletin contains brief abstracts of the results of food studies of about 30 grain and insect eating birds belonging to 10 different families.[1]

These species comprise among others the crow blackbirds and ricebirds, against which serious complaints have been made on account of the damage they do to corn, wheat, rice, and other crops; and also the cuckoos, grosbeaks, and thrashers, which are generally admitted to be beneficial, but whose true value as insect destroyers has not been fully appreciated. The practical value of birds in controlling insect pests should be more generally recognized. It may be an easy matter to exterminate the birds in an orchard or grain field, but it is an extremely difficult one to control the insect pests. It is certain, too, that the value of our native sparrows as weed destroyers is not appreciated. Weed seed forms an important item of the winter food of many of these birds, and it is impossible to estimate the immense numbers of noxious weeds which are thus annually destroyed.

[1] The limits of this bulletin preclude giving more than a very brief statement regarding the food of each bird, but more detailed accounts of some of the species will be found in the following reports of the Biological Survey (formerly Division of Ornithology and Mammalogy): The Cuckoos—Bulletin No. 9, 1898, pp. 1-14; Crow—Bulletin No. 6, 1895, pp. 1-98; Woodpeckers—Bulletin No. 7, 1895, pp. 1-39; Kingbird—Annual Report Secretary of Agriculture for 1893, pp. 233-234; Redwinged Blackbird—Yearbook for 1897, pp. 349-351; Baltimore Oriole—Yearbook for 1895, pp. 126-130; Grackles—Yearbook for 1894, pp. 233-248; Meadowlark—Yearbook for 1895, pp. 420-426; Cedarbird—Annual Report Secretary of Agriculture for 1892, pp. 197-200; Catbird, Brown Thrasher, and Wren—Yearbook for 1895, pp. 405-418.

If birds are protected and encouraged to nest about the farm and garden, they will do their share in destroying noxious insects and weeds, and a few hours spent in putting up boxes for bluebirds, martins, and wrens will prove a good investment. Birds are protected by law in many States, but it remains for the agriculturists to see that the laws are faithfully observed.

THE CUCKOOS.

(*Coccyzus americanus* and *C. erythrophthalmus.*)

Two species of cuckoos, the yellow-billed (fig. 1) and the black-billed, are common in the United States east of the Plains, and a subspecies of the yellow-billed extends westward to the Pacific. While the two species are quite distinct, they do not differ greatly in food habits, and their economic status is practically the same.

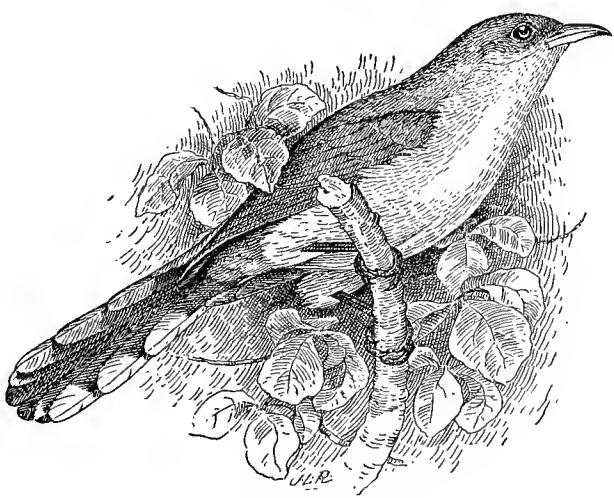


FIG. 1.—Yellow-billed cuckoo.

An examination of 155 stomachs has shown that these cuckoos are much given to eating caterpillars, and, unlike most birds, do not reject those covered with hair. In fact, cuckoos eat so many hairy caterpillars that the hairs pierce the inner lining of the stomach and remain there, so that when the stomach is opened and turned inside out, it appears to be lined with a thin coating of fur.

An examination of the stomachs of 46 black-billed cuckoos, taken during the summer months, showed the remains of 906 caterpillars, 44 beetles, 96 grasshoppers, 100 sawflies, 30 stink bugs, and 15 spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy, and many of them belonged to a genus that lives in colonies and feeds on the leaves of trees, including the apple tree. One stomach was filled with larvæ of a caterpillar belonging to the

same genus as the tent caterpillar, while others contained that species. Other larvæ were those of large moths, for which the bird seems to have a special fondness. The beetles were mainly click beetles and weevils, with a few May beetles. The sawflies were all found in two stomachs, one of which contained no less than 100 in the larval stage.

Of the yellow-billed cuckoo, 109 stomachs (collected from May to October, inclusive) were examined. The contents consisted of 1,865 caterpillars, 93 beetles, 242 grasshoppers, 37 sawflies, 69 bugs, 6 flies, and 86 spiders. Most of the caterpillars belonged to hairy species and many of them were of large size. One stomach contained 250 American tent caterpillars; another 217 fall webworms. In places where tent caterpillars are abundant they seem to constitute a large portion of the food of these two birds. The beetles were distributed among several families, but all more or less harmful to agriculture. In the same stomach which contained the tent caterpillars were two Colorado potato beetles; in another were three goldsmith beetles and remains of several other large beetles. Besides grasshoppers were several katydids and tree crickets. The sawflies were in the larval stage, in which they resemble caterpillars so closely that they are commonly called false caterpillars, and perhaps this likeness may be the reason the cuckoos eat them so freely. The bugs consisted of stink bugs and cicadas or dog-day harvest flies, with the single exception of one wheel bug, which was the only useful insect eaten, unless the spiders be counted as such.

THE WOODPECKERS.

Five or six species of woodpeckers are familiarly known throughout the eastern United States, and in the west are replaced by others of similar habits. Several species remain in the northern States through the entire year, while others are more or less migratory.

Farmers are prone to look upon wookpeckers with suspicion. When the birds are seen scrambling over fruit trees and pecking at the bark, and fresh holes are found in the tree, it is concluded that they are doing harm. Careful observers, however, have noticed that, excepting a single species, these birds rarely leave any important mark on a healthy tree, but that when a tree is affected by wood-boring larvæ the insects are accurately located, dislodged, and devoured. In case the holes from which the borers are taken are afterwards occupied by colonies of ants, these ants in turn are drawn out and eaten.

Two of the best known woodpeckers, the hairy woodpecker (*Dryobates villosus*) (fig. 2) and the downy woodpecker (*D. pubescens*), including their races, range over the greater part of the United States, and for the most part remain throughout the year in their usual haunts. They differ chiefly in size, for their colors are practically the same, and the males, like other woodpeckers, are distinguished by a scarlet patch on the head.

An examination of many stomachs of these two birds shows that from two-thirds to three-fourths of the food consists of insects, chiefly noxious. Wood-boring beetles, both adults and larvæ, are conspicuous, and with them are associated many caterpillars, mostly species that burrow into trees. Next in importance are the ants that live in decaying wood, all of which are sought by woodpeckers and eaten in great quantities. Many ants are particularly harmful to timber, for if they find a small spot of decay in the vacant burrow of some wood-borer, they enlarge the hole, and as their colony is always on the increase, continue to eat away the wood until the whole trunk is honey-

FIG. 2.—Hairy woodpecker.

combed. Moreover, these insects are not accessible to other birds, and could pursue their career of destruction unmolested were it not that the woodpeckers, with beaks and tongues especially fitted for such work, dig out and devour them. It is thus evident that woodpeckers are great conservators of forests. To them, more than to any other agency, we owe the preservation of timber from hordes of destructive insects.

One of the larger woodpeckers familiar to everyone is the flicker, or golden-winged woodpecker (*Colaptes auratus*) (fig. 3), which is generally distributed throughout the United States from the Atlantic Coast to

the Rocky Mountains. It is there replaced by the red-shafted flicker (*C. cafer*), which extends westward to the Pacific. The two species are as nearly identical in food habits as their environment will allow. The flickers, while genuine woodpeckers, differ somewhat in habits from the rest of the family, and are frequently seen upon the ground searching for food. Like the downy and hairy woodpeckers, they eat wood-boring grubs and ants, but the number of ants eaten is much greater. Two of the flickers' stomachs examined were completely filled with ants, each stomach containing more than 3,000 individuals. These ants belonged to species which live in the ground, and it is these insects for which the flicker is searching when running about in the grass, although some grasshoppers are also taken.

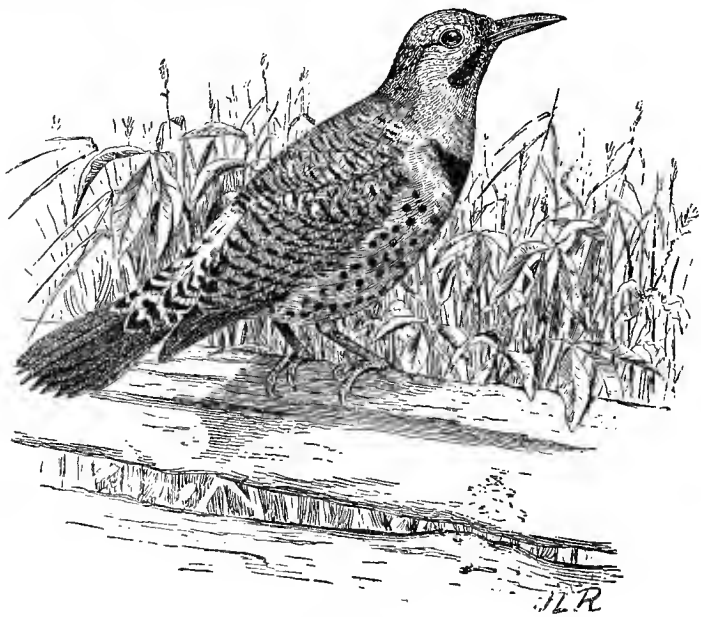


FIG. 3.—Flicker.

The red-headed woodpecker (*Melanerpes erythrocephalus*) (fig. 4) is well known east of the Rocky Mountains, but is rather rare in New England. Unlike some of the other species, it prefers fence posts and telegraph poles to trees as a foraging ground. Its food therefore naturally differs from that of the preceding species, and consists largely of adult beetles and wasps, which it frequently captures on the wing, after the fashion of flycatchers. Grasshoppers also form an important part of the food. The redhead has a peculiar habit of selecting very large beetles, as shown by the presence of fragments of several of the largest species in the stomachs. Among the beetles were quite a number of predaceous ground beetles, and unfortunately some tiger beetles, which are useful insects. The redhead has been accused of robbing the nests

of other birds; also of attacking young birds and poultry and pecking out their brains, but as the stomachs showed little evidence to substantiate this charge it is probable that the habit is rather exceptional.

It has been customary to speak of the smaller woodpeckers as "sapsuckers," under the belief that they drill holes in the bark of trees for the purpose of drinking the sap and eating the inner bark. Close observation, however, has fixed this habit upon only one species, the yellow-bellied woodpecker, or sapsucker (*Sphyrapicus varius*) (fig 5). This bird has been shown to be guilty of pecking holes in the bark of various forest trees, and sometimes in that of apple trees, from which it drinks the sap

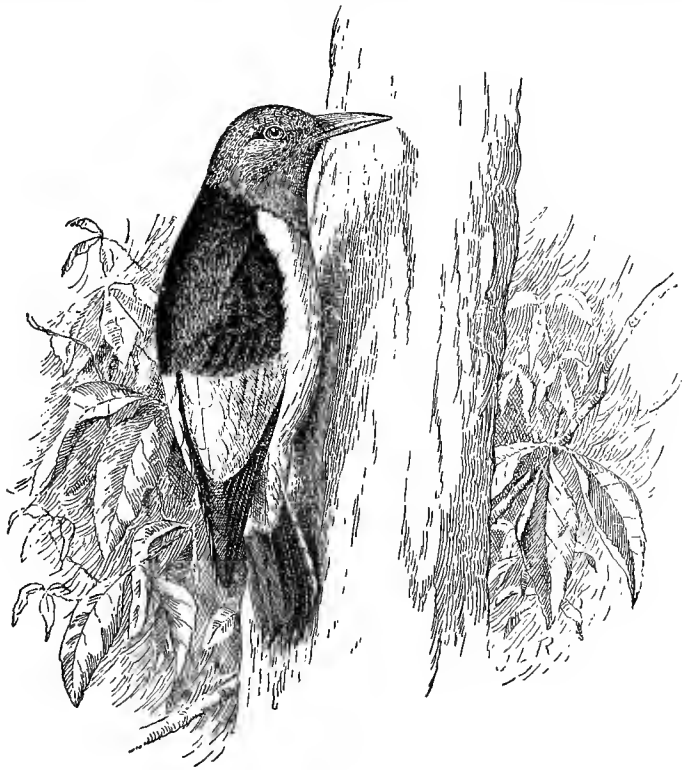


FIG. 4.—Red-headed woodpecker.

when the pits become filled. It has been proved, however, that besides taking the sap the bird captures large numbers of insects which are attracted by the sweet fluid, and that these form a very considerable portion of its diet. In some cases the trees are injured by being thus punctured, and die in a year or two, but since comparatively few are touched the damage is not great. It is equally probable, moreover, that the bird fully compensates for this injury by the insects it consumes.

The vegetable food of woodpeckers is varied, but consists largely of small fruits and berries. The downy and hairy woodpeckers eat such fruits as dogwood, Virginia creeper, and others, with the seeds of

poison ivy, sumac, and a few other shrubs. The flicker also eats a great many small fruits and the seeds of a considerable number of shrubs and weeds. None of the three species is much given to eating cultivated fruits or crops.

The redhead has been accused of eating the larger kinds of fruit, such as apples, and also of taking considerable corn. The stomach examinations show that to some extent these charges are substantiated, but that the habit is not prevalent enough to cause much damage. It is quite fond of mast, especially beechnuts, and when these nuts are

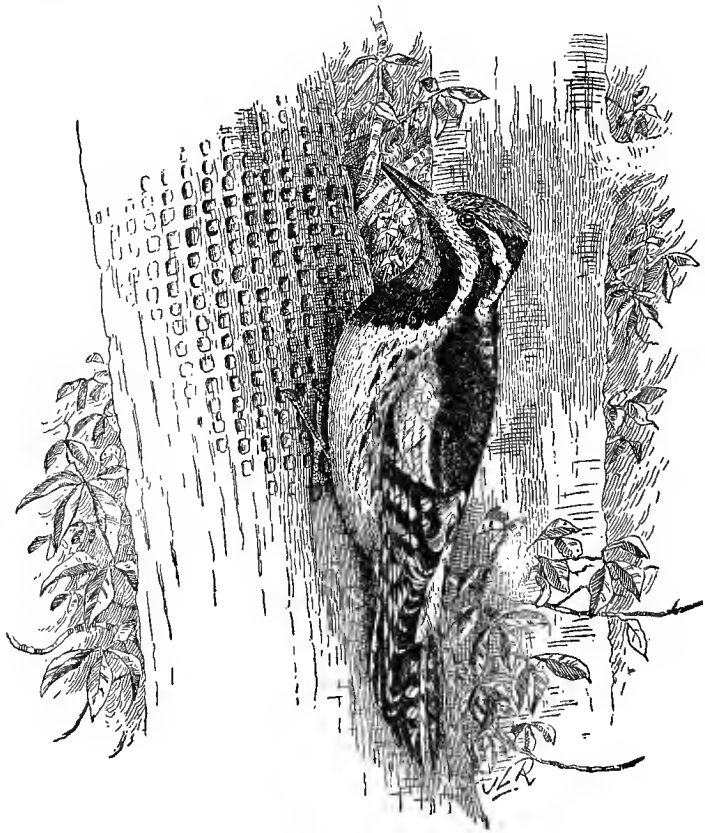


FIG. 5.—Yellow-bellied woodpecker.

plentiful the birds remain north all winter, instead of migrating as is their usual custom.

Half the food of the sapsucker, aside from sap, consists of vegetable matter, largely berries of the kinds already mentioned, and also a quantity of the inner bark of trees, more of which is eaten by this species than by any other.

Many other woodpeckers are found in America, but their food habits agree in the main with those just described. These birds are certainly

the only agents which can successfully cope with certain insect enemies of the forests, and, to some extent, of fruit tree salso. For this reason, if for no other, they should be protected in every possible way.

THE KINGBIRD.

(*Tyrannus tyrannus.*)

The kingbird (fig. 6) is essentially a lover of the orchard, and wherever the native groves have been replaced by fruit trees this pugnacious bird takes up its abode. It breeds in all of the States east of the Rocky Mountains, and less commonly in the Great Basin and on the Pacific Coast. It migrates south early in the fall, and generally leaves the United States to spend the winter in more southern latitudes.

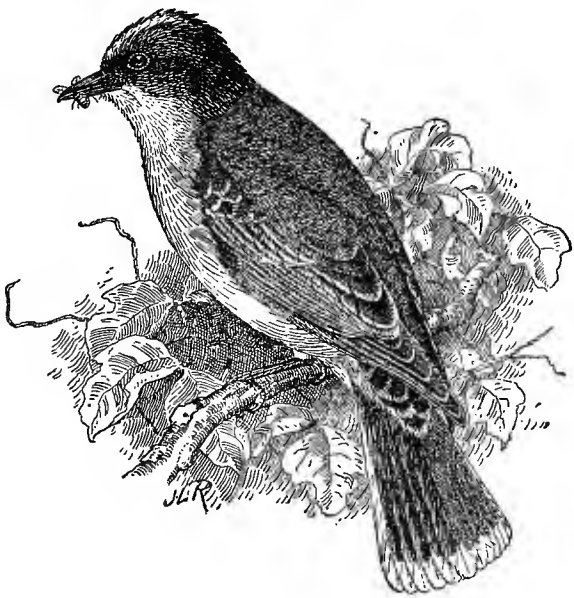


FIG. 6.—Kingbird.

The kingbird manifests its presence in many ways. It is somewhat boisterous and obtrusive, and its antipathy for hawks and crows is well known. It never hesitates to give battle to any of these marauders, no matter how superior in size, and for this reason a family of kingbirds is a desirable adjunct to a poultry yard. On one occasion in the knowledge of the writer a hawk which attacked a brood of young turkeys was pounced upon and so severely buffeted by a pair of kingbirds, whose nest was near by, that the would-be robber was glad to escape without his prey. Song birds that nest near the kingbird are similarly protected.

In its food habits this species is largely insectivorous. It is a true flycatcher by nature, and takes a large part of its food on the wing. It

does not, however, confine itself to this method of hunting, but picks up some insects from trees and weeds, and even descends to the ground in search of myriapods or thousand legs. The chief complaint against the kingbird is that it preys largely upon honeybees; and this charge has been made both by professional bee keepers and others. Many observers have seen the bird at work near hives, and there is no reason to doubt the honesty of their testimony. One bee raiser in Iowa, suspecting the kingbirds of feeding upon his bees, shot a number near his hives, but when the birds' stomachs were examined by an expert entomologist not a trace of honeybees could be found.

The Biological Survey has made an examination of 281 stomachs collected in various parts of the country, but found only 14 containing remains of honeybees. In these 14 stomachs there were in all 50 honeybees, of which 40 were drones, 4 were certainly workers, and the remaining 6 were too badly broken to be identified as to sex.

The insects that constitute the great bulk of the food of this bird are noxious species, largely beetles—May beetles, click beetles (the larvæ of which are known as wire worms), weevils, which prey upon fruit and grain, and a host of others. Wasps, wild bees, and ants are conspicuous elements of the food, far outnumbering the hive bees. During summer many grasshoppers and crickets, as well as leaf hoppers and other bugs, are also eaten. Among the flies were a number of robber flies—insects which prey largely upon other insects, especially honeybees, and which have been known to commit in this way extensive depredations. It is thus evident that the kingbird by destroying these flies actually does good work for the apiarist. Nineteen robber flies were found in the stomachs examined; these may be considered more than an equivalent for the four worker honeybees already mentioned. A few caterpillars are eaten, mostly belonging to the group commonly known as cutworms, all the species of which are harmful. About 10 per cent of the food consists of small native fruits, comprising some twenty common species of the roadsides and thickets, such as dogwood berries, elder berries, and wild grapes. The bird has not been reported as eating cultivated fruit to an injurious extent, and it is very doubtful if this is ever the case, for cherries and blackberries are the only ones that might have come from cultivated places, and they were found in but few stomachs.

Three points seem to be clearly established in regard to the food of the kingbird—(1) that about 90 per cent consists of insects, mostly injurious species; (2) that the alleged habit of preying upon honeybees is much less prevalent than has been supposed, and probably does not result in any great damage; and (3) that the vegetable food consists almost entirely of wild fruits which have no economic value. These facts, taken in connection with its well-known enmity for hawks and crows, entitle the kingbird to a place among the most desirable birds of the orchard or garden.

THE PHŒBE.

(*Sayornis phœbe.*)

Among the early spring arrivals at the North, none are more welcome than the phœbe (fig. 7). Though naturally building its nest under an overhanging cliff of rock or earth, or in the mouth of a cave, its preference for the vicinity of farm buildings is so marked that in the more thickly settled parts of the country the bird is seldom seen at any great distance from a farmhouse except where a bridge spans some stream, affording a secure spot for a nest. Its confiding disposition has rendered it a great favorite, and consequently it is seldom disturbed. It breeds throughout the United States east of the Great Plains, and winters from the South Atlantic and Gulf States southward.

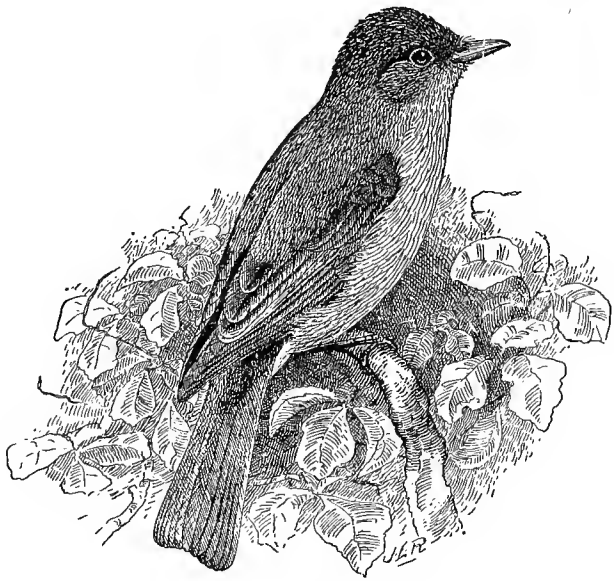


FIG. 7.—Phœbe.

The phœbe subsists almost exclusively upon insects, most of which are caught upon the wing. An examination of 80 stomachs showed that over 93 per cent of the year's food consists of insects and spiders, while wild fruit constitutes the remainder. The insects belong chiefly to noxious species, and include many click beetles, May beetles, and weevils. Grasshoppers in their season are eaten to a considerable extent, while wasps of various species, many flies of species that annoy cattle, and a few bugs and spiders are also eaten regularly. It is evident that a pair of phœbes must materially reduce the number of insects near a garden or field, as the birds often, if not always, raise two broods a year, and each brood numbers from four to six young.

The vegetable portion of the food is unimportant, and consists mainly of a few seeds, with small fruits, such as wild cherries, elder berries, and

juniper berries. The raspberries and blackberries found in the stomachs were the only fruits that might have belonged to cultivated varieties, and the quantity was trifling.

There is hardly a more useful species than the phœbe about the farm, and it should receive every encouragement. To furnish nesting boxes is unnecessary, as it usually prefers a more open situation, like a shed, or a nook under the eaves, but it should be protected from cats and other marauders.

THE BLUE JAY.

(*Cyanocitta cristata.*)

The blue jay (fig. 8) is a common bird of the United States east of the Great Plains, and remains throughout the year in most of its range, although its numbers are somewhat reduced in winter in the Northern States. During spring and summer the jay is forced to become an

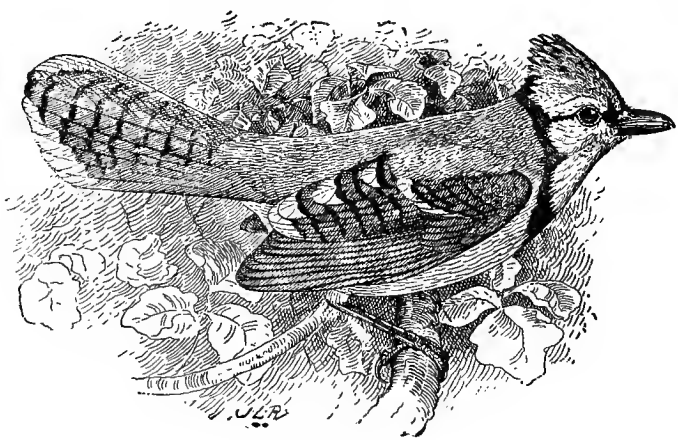


FIG. 8.—Blue jay.

industrious hunter for insects, and is not so conspicuous a feature of the landscape as when it roams the country at will after the cares of the nesting season are over.

Ornithologists and field observers in general declare that a considerable portion of its food in spring and early summer consists of the eggs and young of small birds, and some farmers accuse it of stealing corn to an injurious extent in the fall. While there may be some truth in these accusations, they have almost certainly been exaggerated. No doubt many jays have been observed robbing nests of other birds, but thousands have been seen that were not so engaged.

In an investigation of the food of the blue jay 292 stomachs were examined, which showed that animal matter comprised 24 per cent and vegetable matter 76 per cent of the bird's diet. So much has been said about the nest-robbing habits of the jay that special search was made for traces of birds or birds' eggs in the stomachs, with the result that shells

of small birds' eggs were found in three and the remains of young birds in only two stomachs. Such negative evidence is not sufficient to controvert the great mass of testimony upon this point, but it shows that the habit is not so prevalent as has been believed. Besides birds and their eggs, the jay eats mice, fish, salamanders, snails, and crustaceans, which altogether constitute but little more than 1 per cent of its diet. The insect food is made up of beetles, grasshoppers, caterpillars, and a few species of other orders, all noxious, except some 3½ per cent of predaceous beetles. Thus something more than 19 per cent of the whole food consists of harmful insects. In August the jay, like many other birds, turns its attention to grasshoppers, which constitute nearly one-fifth of its food during that month. At this time, also, most of the other noxious insects, including caterpillars, are consumed, though beetles are eaten chiefly in spring.

The vegetable food is quite varied, but the item of most interest is grain. Corn was found in 70 stomachs, wheat in 8, and oats in 2—all constituting 19 per cent of the total food. Corn is evidently the favorite grain, but a closer inspection of the record shows that the greater part was eaten during the first five months of the year, and that very little was taken after May, even in harvest time, when it is abundant. This indicates that most of the corn is gleaned from the fields after harvest, except what is stolen from cribs or gathered in May at planting time.

The jay's favorite food is mast (i. e., acorns, chestnuts, chinquapins, etc.), which was found in 158 of the 292 stomachs and amounted to more than 42 per cent of the whole food. In September corn formed 15 and mast 35 per cent, while in October, November, and December corn dropped to an almost inappreciable quantity and mast amounted to 64, 82, and 83 per cent, respectively. And yet in these months corn is abundant and everywhere easily accessible. The other elements of food consist of a few seeds and wild fruits, among which grapes and blackberries predominate.

The results of the stomach examination show, (1) that the jay eats many noxious insects; (2) that its habit of robbing the nests of other birds is much less common than has been asserted; and (3) that it does little harm to agriculture, since all but a small amount of the corn eaten is waste grain.

THE CROW.

(*Corvus americanus.*)

There are few birds so well known as the common crow, and unlike most other species he does not seem to decrease in numbers as the country becomes more densely populated. The crow is commonly regarded as a blackleg and a thief. Without the dash and brilliancy of the jay, or the bold savagery of the hawk, he is accused of doing more mischief than either. That he does pull up sprouting corn, destroy chickens, and rob the nests of small birds has been repeatedly

proved. Nor are these all of his sins. He is known to eat frogs, toads, salamanders, and some small snakes, all harmless creatures that do some good by eating insects. With so many charges against him, it may be well to show why he should not be utterly condemned.

The examination of a large number of stomachs, while confirming all the foregoing accusations, has thrown upon the subject a light somewhat different from that derived solely from field observation. It shows that the bird's-nesting habit, as in the case of the jay, is not so universal as has been supposed; and that, so far from being a habitual nest robber, the crow only occasionally indulges in that reprehensible practice. The same is true in regard to destroying chickens, for he is able to carry off none but very young ones, and his opportunities for capturing them are somewhat limited. Neither are many toads and frogs eaten, and as frogs are of no great practical value, their destruction is not a serious matter; but toads are very useful, and their consumption, so far as it goes, must be counted against the crow. Turtles, crayfishes, and snails, of which he eats quite a large number, may be considered neutral, while mice may be counted to his credit.

In his insect food, however, the crow makes amends for sins in the rest of his dietary, although even here the first item is against him. Predaceous beetles are eaten in some numbers throughout the season, but the number is not great. May beetles, "dor-bugs," or June bugs, and others of the same family, constitute the principal food during spring and early summer, and are fed to the young in immense quantities. Other beetles, nearly all of a noxious character, are eaten to a considerable extent. Grasshoppers are first taken in May, but not in large numbers until August, when, as might be expected, they form the leading article of diet, showing that the crow is no exception to the general rule that most birds subsist, to a large extent, upon grasshoppers in the month of August. Many bugs, some caterpillars, mostly cutworms, and some spiders are also eaten—all of them either harmful or neutral in their economic relations. Of the insect diet Mr. E. A. Schwarz says: "The facts, on the whole, speak overwhelmingly in favor of the crow."

Probably the most important item in the vegetable food is corn, and by pulling up the newly sprouted seeds the bird renders himself extremely obnoxious. Observation and experiments with tame crows show that hard, dry corn is never eaten if anything else is to be had, and if fed to nestlings it is soon disgorged. The reason crows resort to newly planted fields is that the kernels of corn are softened by the moisture of the earth, and probably become more palatable in the process of germination, which changes the starch of the grain to sugar. The fact, however, remains that crows eat corn extensively only when it has been softened by germination or partial decay, or before it is ripe and still "in the milk." Experience has shown that they may be prevented from pulling up young corn by tarring the seed, which not only saves the corn but forces them to turn their attention to insects. If

they persist in eating green corn it is not so easy to prevent the damage; but no details of extensive injury in this way have yet been presented, and it is probable that no great harm has been done.

Crows eat fruit to some extent, but confine themselves for the most part to wild species, such as dogwood, sour gum, and seeds of the different kinds of sumac. They have also a habit of sampling almost everything which appears eatable, especially when food is scarce. For example, they eat frozen apples found on the trees in winter, or pumpkins, turnips, and potatoes which have been overlooked or neglected; even mushrooms are sometimes taken, probably in default of something better.

In estimating the economic status of the crow, it must be acknowledged that he does some damage, but, on the other hand, he should receive much credit for the insects which he destroys. In the more thickly settled parts of the country the crow probably does more good than harm, at least when ordinary precautions are taken to protect young poultry and newly-planted corn against his depredations. If, however, corn is planted with no provision against possible marauders, if hens and turkeys are allowed to nest and to roam with their broods at a distance from farm buildings, losses must be expected.

THE BOBOLINK, OR RICEBIRD.

(*Dolichonyx oryzivorus.*)

The bobolink (fig. 9) is a common summer resident of the United States, north of about latitude 40°, and from New England westward to the Great Plains, wintering beyond our southern border. In New England there are few birds, if any, around which so much romance has clustered; in the South none on whose head so many maledictions have been heaped. The bobolink, entering the United States from the South at a time when the rice fields are freshly sown, pulls up the young plants and feeds upon the seed. Its stay, however, is not long, and it soon hastens northward, where it is welcomed as a herald of summer. During its sojourn in the Northern States it feeds mainly upon insects and small seeds of useless plants; but while rearing its young, insects constitute its chief food, and almost the exclusive diet of its brood. After the young are able to fly, the whole family gathers into a small flock and begins to live almost entirely upon vegetable food. This consists for the most part of weed seeds, since in the North these birds do not appear to molest grain to any great extent. They eat a few oats, but their stomachs do not reveal a great quantity of this or any other grain. As the season advances they gather into larger flocks and move southward, until by the end of August nearly all have left their breeding grounds. On their way they frequent the reedy marshes about the mouths of rivers and on the inland waters of the coast region, subsisting largely upon wild rice. After leaving the Northern States they are commonly known as reed birds, and having become very fat are treated as game.

They begin to arrive on the rice fields in the latter part of August and during the next month make havoc in the ripening crop. It is unfortunate that the rice districts lie exactly in the track of their fall migration, since the abundant supply of food thus offered has undoubtedly served to attract them more and more, until most of the bobolinks bred in the North are concentrated with disastrous effect on the southeast coast when the rice ripens in the fall. There was evidently a time when no such supply of food awaited the birds on their journey southward, and it seems probable that the introduction of rice culture in the South, combined with the clearing of the forests in the North, thus affording a larger available breeding area, has favored an increase in the

FIG. 9.—Bobolink.

numbers of this species. The food habits of the bobolink are not necessarily inimical to the interests of agriculture. It simply happens that the rice affords a supply of food more easily obtainable than did the wild plants which formerly occupied the same region. Were the rice fields at a distance from the line of migration, or north of the bobolinks' breeding ground, they would probably never be molested; but lying, as they do, directly in the path of migration, they form a recruiting ground, where the birds can rest and accumulate flesh and strength for the long sea flight which awaits them in their course to South America.

The annual loss to rice growers on account of bobolinks has been estimated at $2,000,000. In the face of such losses it is evident that

no mere poetical sentiment should stand in the way of applying any remedy which can be devised. It would be unsafe to assume that the insects which the birds consume during their residence in the North can compensate for such destruction. If these figures are any approximation to the truth, the ordinary farmer will not believe that the bobolink benefits the Northern half of the country nearly as much as it damages the Southern half, and the thoughtful ornithologist will be inclined to agree with him. But even if the bird really does more harm than good, what is the remedy? For years the rice planters have been employing men and boys to shoot the birds and drive them away from the fields, but in spite of the millions slain every year their numbers do not decrease. In fact, a large part of the loss sustained is not in the grain which the birds actually eat, but in the outlay necessary to prevent them from taking it all. At present there seems to be no effective remedy short of complete extermination of the species, and this is evidently impracticable even were it desirable.

THE REDWINGED BLACKBIRD.

(*Agelaius phœniceus.*)

The redwinged, or swamp, blackbird (fig. 10) is found all over the United States and the region immediately to the north. While common in most of its range, its distribution is more or less local, mainly on account of its partiality for swamps. Its nest is built near standing water, in tall grass, rushes, or bushes. Owing to this peculiarity the bird may be absent from large tracts of country which afford no swamps or marshes suitable for nesting. It usually breeds in large colonies, though single families, consisting of a male with several wives, may sometimes be found in a small slough, where each of the females builds her nest and rears her own little brood, while her liege lord displays his brilliant colors and struts in the sunshine. In the Upper Mississippi Valley it finds the conditions most favorable, for the countless prairie sloughs and the margins of the numerous shallow lakes form nesting sites for thousands of redwings; and there are bred the immense flocks which sometimes do so much damage to the grain fields of the West. After the breeding season is over, the birds collect in flocks to migrate, and remain thus associated throughout the winter.

Many complaints have been made against the redwing, and several States have at times placed a bounty upon its head. It is said to cause great damage to grain in the West, especially in the Upper Mississippi Valley; and the rice growers of the South say that it eats rice. No complaints have been received from the Northeastern portion of the country, where the bird is much less abundant than in the West and South.

An examination of 725 stomachs showed that vegetable matter forms 74 per cent of the food, while the animal matter, mainly insects, forms

but 26 per cent. A little more than 10 per cent consists of beetles, mostly harmful species. Weevils, or snout beetles, amount to 4 per cent of the year's food, but in June reach 25 per cent. As weevils are among the most harmful insects known, their destruction should condone for at least some of the sins of which the bird has been accused. Grasshoppers constitute nearly 5 per cent of the food, while the rest of the animal matter is made up of various insects, a few snails, and crustaceans. Several dragon flies were found, but these were probably picked up dead, for they are too active to be taken alive, unless by one of the flycatchers. So far as the insect food as a whole is concerned, the redwing may be considered entirely beneficial.

The interest in the vegetable food of this bird centers around the

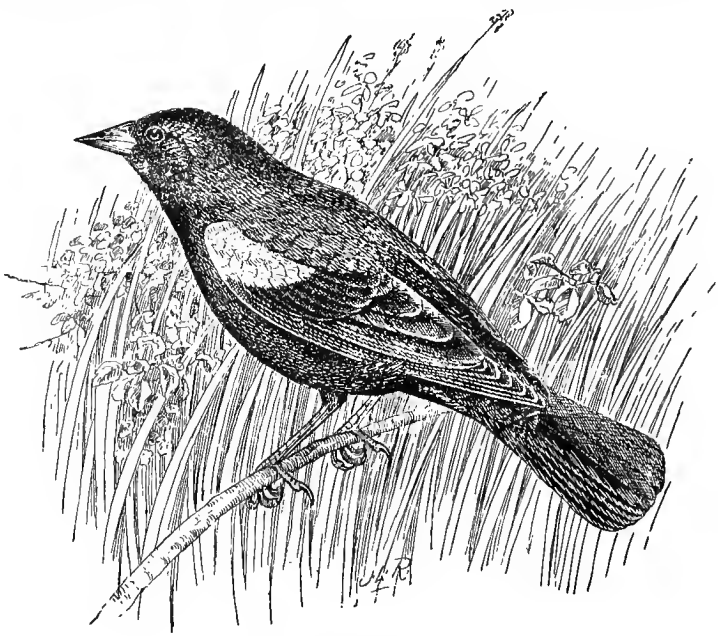


FIG. 10.—Redwinged blackbird.

grain. Only three kinds, corn, wheat, and oats, were found in appreciable quantities in the stomachs, and they aggregate but little more than 13 per cent of the whole food, oats forming nearly half of this amount. In view of the many complaints that the redwing eats grain, this record is surprisingly small. The crow blackbird has been found to eat more than three times as much. In the case of the crow, corn forms one-fifth of the food, so that the redwinged blackbird, whose diet is made up of only a trifle more than one-eighth of grain, is really one of the least destructive species; but the most important item of this bird's food is weed seed, which forms practically the whole food in winter and about 57 per cent of the whole year's fare. The principal weed seeds

eaten are those of ragweed, barn grass, smartweed, and about a dozen others. That these seeds are preferred is shown by the fact that the birds begin to eat them in August, when grain is still readily accessible, and continue feeding on them even after insects become plentiful in April. The redwing eats very little fruit and does practically no harm in the garden or orchard.

While it is impossible to dispute the mass of testimony which has accumulated concerning its grain-eating propensity, the stomach examinations show that the habit must be local rather than general. As the area of cultivation increases and the breeding grounds are curtailed, the species is likely to become reduced in numbers and consequently less harmful. Nearly seven-eighths of the redwing's food is made up of weed seed or of insects injurious to agriculture, indicating unmistakably that the bird should be protected, except, perhaps, in a few places where it is too abundant.

THE MEADOW LARK, OR OLD FIELD LARK.

(Sturnella magna.)

The meadow lark (fig. 11) is a common and well-known bird occurring from the Atlantic Coast to the Great Plains, where it gives way to a closely related subspecies, which extends thence westward to the Pacific. It winters from our southern border as far north as the District of Columbia, southern Illinois, and occasionally Iowa. Although it is a bird of the plains, finding its most congenial haunts in the prairies of the West, it does not disdain the meadows and mowing lands of New England. It nests on the ground and is so terrestrial in its habits that it seldom perches on trees, preferring a fence rail or a telegraph pole. When undisturbed, it may be seen walking about with a peculiar dainty step, stopping every few moments to look about and give its tail a nervous flirt or to sound a note or two of its clear whistle.

The meadow lark is almost wholly beneficial, although a few complaints have been made that it pulls sprouting grain, and one farmer claims that it eats clover seed. As a rule, however, it is looked upon with favor and is not disturbed.

In the 238 stomachs examined, animal food (practically all insects) constituted 73 per cent of the contents and vegetable matter 27 per cent. As would naturally be supposed, the insects were ground species, such as beetles, bugs, grasshoppers, and caterpillars, with a few flies, wasps, and spiders. A number of the stomachs were taken from birds that had been killed when the ground was covered with snow, but still they contained a large percentage of insects, showing the bird's skill in finding proper food under adverse circumstances.

Of the various insects eaten, crickets and grasshoppers are the most important, constituting 29 per cent of the entire year's food and 69 per cent of the food in August. It is scarcely necessary to enlarge upon

this point, but it can readily be seen what an effect a number of these birds must have on a field of grass in the height of the grasshopper season. Of the 238 stomachs collected at all seasons of the year, 178, or more than two-thirds, contained remains of grasshoppers, and one was filled with fragments of 37 of these insects. This seems to show conclusively that grasshoppers are preferred and are eaten whenever they can be procured. The great number taken in August is especially noticeable. This is essentially the grasshopper month, i. e., the month when grasshoppers reach their maximum abundance; and the stomach examination has shown that a large number of birds resort to this diet in August, no matter what may be the food during the rest of the year.

Next to grasshoppers, beetles make up the most important item of the meadow lark's food, amounting to nearly 21 per cent, of which about one-third are predaceous ground beetles. The others are all harmful

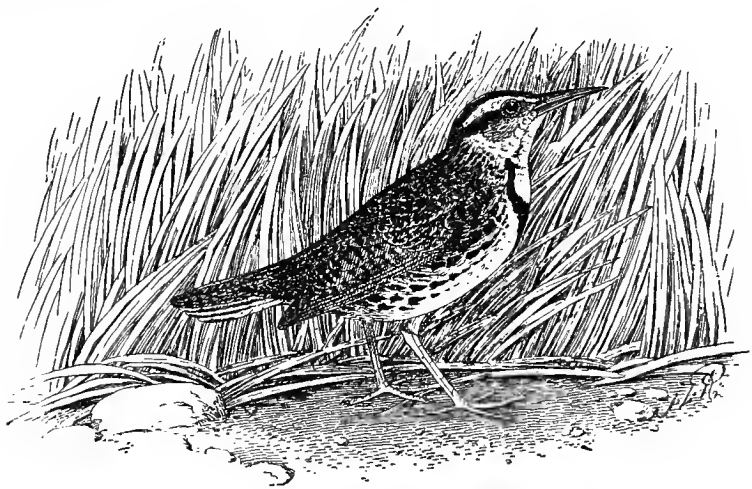


FIG. 11.—Meadow lark.

species, and when it is considered that the bird feeds exclusively on the ground, it seems remarkable that so few useful ground beetles are eaten. Many of them have a disgusting odor, and possibly this may occasionally save them from destruction by birds, especially when other food is abundant. Caterpillars, too, form a very constant element, and in May constitute over 28 per cent of the whole food. May is the month when the dreaded cutworm begins its deadly career, and then the bird does some of its best work. Most of these caterpillars are ground feeders, and are overlooked by birds which habitually frequent trees; but the meadow lark finds them and devours them by thousands. The remainder of the insect food is made up of a few ants, wasps, and spiders, with a few bugs, including some chinch bugs.

The vegetable food consists of grain, weed, and other hard seeds. Grain in general amounts to 14, and weed and other seeds to 12 per cent.

The grain, principally corn, is mostly eaten in winter and early spring, and must be therefore simply waste kernels; only a trifle is consumed in summer and autumn, when it is most plentiful. No trace of sprouting grain was discovered. Clover seed was found in only six stomachs, and but little in each. Seeds of weeds, principally ragweed, barn grass, and smartweed, are eaten from November to April, inclusive, but during the rest of the year are replaced by insects.

Briefly stated, more than half of the meadow lark's food consists of harmful insects; its vegetable food is composed either of noxious weeds or waste grain, and the remainder is made up of useful beetles or neutral insects and spiders. A strong point in the bird's favor is that, although naturally an insect eater, it is able to subsist on vegetable food, and consequently is not forced to migrate in cold weather any farther than is necessary to find ground free from snow. This explains why it remains for the most part in the United States during winter, and moves northward as soon as the snow disappears from its usual haunts.

There is one danger to which the meadow lark is exposed. As its flesh is highly esteemed the bird is often shot for the table, but it is entitled to all possible protection, and to slaughter it for game is the least profitable way to utilize a valuable species.

THE BALTIMORE ORIOLE.

(*Icterus galbula.*)

Brilliancy of plumage, sweetness of song, and food habits to which no exception can be taken are some of the striking characteristics of the Baltimore oriole (fig. 12). In summer this species is found throughout the northern half of the United States east of the Great Plains, and is welcomed and loved in every country home in that broad land. In the Northern States it arrives rather late, and is usually first seen, or heard, foraging amidst the early bloom of the apple trees, where it searches for caterpillars or feeds daintily on the surplus blossoms. Its nest commands hardly less admiration than the beauty of its plumage or the excellence of its song. Hanging from the tip of the outermost bough of a stately elm, it is almost inaccessible, and so strongly fastened as to bid defiance to the elements.

By watching an oriole which has a nest one may see it searching among the smaller branches of some neighboring tree, carefully examining each leaf for caterpillars, and occasionally trilling a few notes to its mate. Observation both in the field and laboratory shows that caterpillars constitute the largest item of its fare. In 113 stomachs they formed 34 per cent of the food, and are eaten in varying quantities during all the months in which the bird remains in this country, although the fewest are eaten in July, when a little fruit is also taken. The other insects consist of beetles, bugs, ants, wasps, grasshoppers, and some spiders. The beetles are principally click beetles, the larvæ of which are among the most destructive insects known; and the bugs

include plant and bark lice, both very harmful, but so small and obscure as to be passed over unnoticed by most birds. Ants are eaten mostly in spring, grasshoppers in July and August, and wasps and spiders with considerable regularity throughout the season.

Vegetable matter amounts to only a little more than 16 per cent of the food during the bird's stay in the United States, so that the possibility of the oriole doing much damage to crops is very limited. The bird has been accused of eating peas to a considerable extent, but remains of peas were found in only two stomachs. One writer says that it damages grapes, but none were found. In fact, a few blackberries and

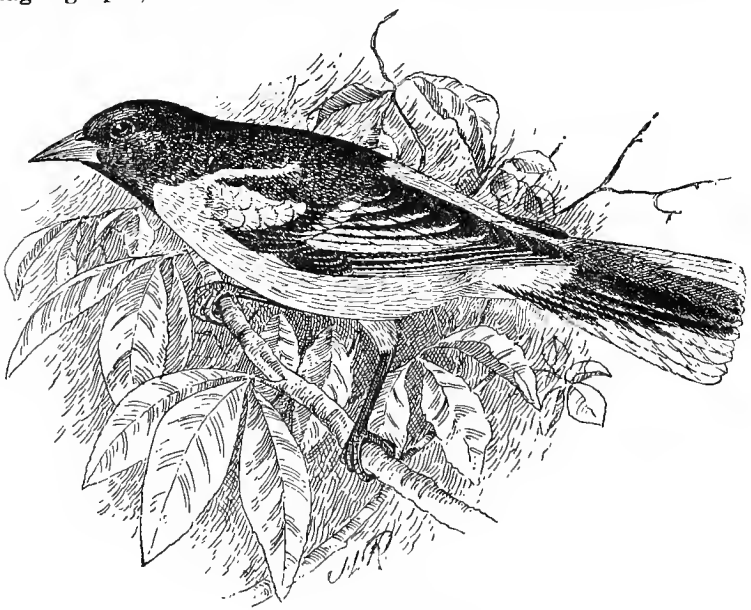


FIG. 12.—Baltimore oriole.

cherries comprised the only cultivated fruit detected in the stomachs, the remainder of the vegetable food being wild fruit and a few miscellaneous seeds.

THE CROW BLACKBIRD, OR GRACKLE.

(*Quiscalus quiscula.*)

The crow blackbird (fig. 13) or one of its subspecies is a familiar object in all of the States east of the Rocky Mountains. It is a resident throughout the year as far north as southern Illinois, and in summer extends its range into British America. In the Mississippi Valley it is one of the most abundant birds, preferring to nest in the artificial groves and windbreaks near farms instead of the natural "timber" which it formerly used. It breeds also in parks and near buildings, often in considerable colonies. Farther east, in New England, it is only locally abundant, though frequently seen in migration. After July it

becomes very rare, or entirely disappears, owing to the fact that it collects in large flocks and retires to some quiet place, where food is abundant and where it can remain undisturbed during the molting season, but in the latter days of August and throughout September it usually reappears in immense numbers before moving southward.

It is evident that a bird so large and so abundant may exercise an important influence upon the agricultural welfare of the country it inhabits. The crow blackbird has been accused of many sins, such as stealing grain and fruit and robbing the nests of other birds; but the farmers do not undertake any war of extermination against it, and, for the most part, allow it to nest about the premises undisturbed. An examination of 2,258 stomachs showed that nearly one-third of its food consists of insects, of which the greater part are injurious. The bird

FIG. 13.—Crow blackbird.

also eats a few snails, crayfishes, salamanders, small fish, and occasionally a mouse. The stomach contents do not indicate that it robs other birds' nests to any great extent, as remains of birds and birds' eggs amount to less than one-half of 1 per cent.

It is, however, on account of its vegetable food that the grackle is most likely to be accused of doing damage. Grain is eaten during the whole year, and during only a short time in summer is other food attractive enough to induce the bird to alter its diet. The grain taken in the winter and spring months probably consists of waste kernels gathered from the stubble. The stomachs do not indicate that the bird pulls sprouting grain; but the wheat eaten in July and August, and the corn eaten in the fall, are probably taken from fields of standing

grain. The total grain consumed during the year constitutes 45 per cent of the whole food, but it is safe to say that at least half is waste grain, and consequently of no value. Although the crow blackbird eats a few cherries and blackberries in their season, and some wild fruit in the fall, it apparently does no damage in this way.

Large flocks of crow blackbirds no doubt do considerable injury to grain crops, and there seems to be no remedy except the destruction of the birds, which is in itself expensive. During the breeding season, however, the species does much good by eating insects and by feeding them to its young, which are reared almost entirely upon this food. The bird does the greatest amount of good in spring, when it follows the plow in search of large grub worms, of which it is so fond that it sometimes literally crams its stomach full of them. The farmer must decide for himself whether or not these birds cause more damage than can be repaid by insect destruction; but when they destroy an entire crop it is no consolation to know that they have already eaten a multitude of insects which, if left alone, would have accomplished the same result.

THE SPARROWS.[1]

Sparrows are not obtrusive birds, either in plumage, song, or action. There are some forty species, with nearly as many subspecies, in North America, but their differences, both in plumage and habits, are in most cases too obscure to be readily recognized, and not more than half a dozen forms are generally known in any one locality. All the species are more or less migratory, but so widely are they distributed that there is probably no part of the country where some can not be found throughout the year.

While sparrows are noted seed eaters, they do not by any means confine themselves to a vegetable diet. During the summer, and especially in the breeding season, they eat many insects, and probably feed their young largely upon the same food. An examination of the stomachs of three species—the song sparrow (*Melospiza*), chipping sparrow (*Spizella socialis*), and field sparrow (*Spizella pusilla*) (fig. 14)—shows that about one-third of the food consists of insects, comprising many injurious beetles, such as snout-beetles or weevils, and leaf-beetles. Many grasshoppers are eaten, and in the case of the chipping sparrow these insects form one eighth of the food. Grasshoppers would seem to be rather large morsels, but the bird probably confines itself to the smaller species; indeed, this is indicated by the fact that the greatest amount (over 36 per cent) is eaten in June, when the larger species are still young and the small species most numerous. Besides the insects already mentioned, many wasps and bugs are taken. Predaceous and parasitic Hymenoptera and predaceous beetles, all useful insects, are

[1]The sparrows here mentioned are all native species. For a full account of the English sparrow, including its introduction, habits, and depredations, see Bull. No. 1 of the Division of Ornithology, published in 1889.

eaten only to a slight extent, so that as a whole the sparrows' insect diet may be considered beneficial.

Their vegetable food is limited almost exclusively to hard seeds This might seem to indicate that the birds feed to some extent upon grain, but the stomachs examined show only one kind—oats—and but little of that. The great bulk of the food is made up of grass and weed seed, which form almost the entire diet during winter, and the amount consumed is immense.

Anyone acquainted with the agricultural region of the Upper Mississippi Valley can not have failed to notice the enormous growth of weeds in every waste spot where the original sward has been disturbed.

FIG. 14.—Field sparrow.

By the roadside, on the borders of cultivated fields, or in abandoned fields, wherever they can obtain a foothold, masses of rank weeds spring up, and often form impenetrable thickets which afford food and shelter for immense numbers of birds and enable them to withstand great cold and the most terrible blizzards. A person visiting one of these weed patches on a sunny morning in January, when the thermometer is 20° or more below zero, will be struck with the life and animation of the busy little inhabitants. Instead of sitting forlorn and half frozen, they may be seen flitting from branch to branch, twittering and fluttering, and showing every evidence of enjoyment and perfect comfort. If one

of them be killed and examined, it will be found in excellent condition—in fact, a veritable ball of fat.

The snowbird (*Junco hyemalis*) and tree sparrow (*Spizella monticola*) are perhaps the most numerous of all the sparrows. The latter fairly swarms all over the Northern States in winter, arriving from the north early in October and leaving in April. Examination of many stomachs shows that in winter the tree sparrow feeds entirely upon seeds of weeds; and probably each bird consumes about one-fourth of an ounce a day. In an article contributed to the New York Tribune in 1881 the writer estimated the amount of weed seed annually destroyed by these birds in the State of Iowa. Upon the basis of one-fourth of an ounce of seed eaten daily by each bird, and supposing that the birds averaged ten to each square mile, and that they remain in their winter range two hundred days, we shall have a total of 1,750,000 pounds, or 875 tons, of weed seed consumed by this one species in a single season. Large as these figures may seem, they certainly fall far short of the reality. The estimate of ten birds to a square mile is much within the truth, for the tree sparrow is certainly more abundant than this in winter in Massachusetts, where the food supply is less than in the Western States, and I have known places in Iowa where several thousand could be seen within the space of a few acres. This estimate, moreover, is for a single species, while, as a matter of fact, there are at least half a dozen birds (not all sparrows) that habitually feed on these seeds during winter.

Farther south the tree sparrow is replaced in winter by the white-throated sparrow, the white-crowned sparrow, the fox sparrow, the song sparrow, the field sparrow, and several others; so that all over the country there are a vast number of these seed eaters at work during the colder months reducing next year's crop of worse than useless plants.

In treating of the value of birds, it has been customary to consider them mainly as insect destroyers; but the foregoing illustration seems to show that seed eaters have a useful function, which has never been fully appreciated.

THE ROSE-BREASTED GROSBEAK.

(*Zamelodia ludoviciana.*)

The beautiful rose-breasted grosbeak (fig. 15) breeds in the northern half of the United States east of the Missouri River, but spends its winters beyond our boundaries. Unfortunately it is not abundant in New England, and nowhere as plentiful as it should be. It frequents groves and orchards rather than gardens or dooryards, but probably the beauty of the male is the greatest obstacle to its increase; the fully adult bird is pure black and white, with a broad patch of brilliant rose color upon the breast and under each wing. On account of this

attractive plumage the birds are highly prized for ladies' hats; and consequently have been shot in season and out, till the wonder is not that there are so few, but that any remain at all.

When the Colorado potato beetle first swept over the land, and naturalists and farmers were anxious to discover whether or not there were any enemies which would prey upon the pest, the grosbeak was almost the only bird seen to eat the beetles. Further observation confirmed the fact, and there can be no reasonable doubt that where the bird is abundant it has contributed very much to the abatement of the pest which has been noted during the last decade. But this is not the only good which the bird does, for many other noxious insects besides the potato beetle are also eaten.

The vegetable food of the grosbeak consists of buds and blossoms of forest trees, and seeds, but the only damage of which it has been

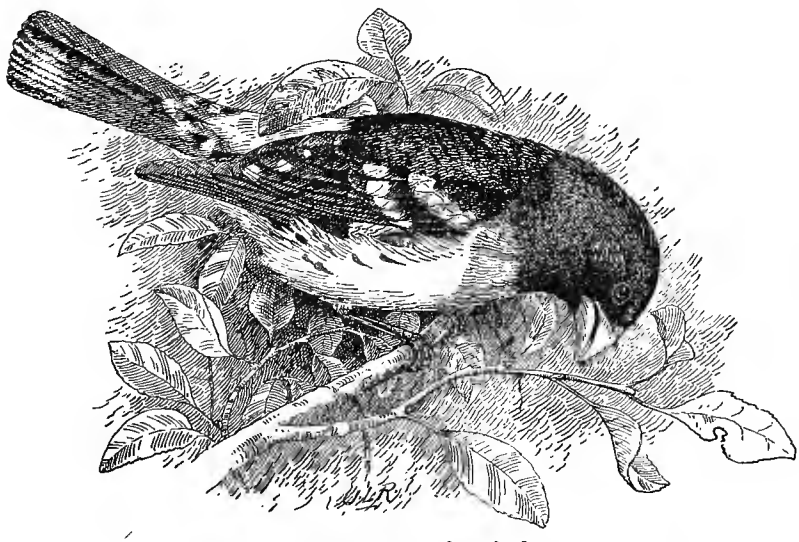


FIG. 15.—Rose-breasted grosbeak.

accused is the stealing of green peas. The writer has observed it eating peas and has examined the stomachs of several that had been killed in the very act. The stomachs contained a few peas and enough potato beetles, old and young, as well as other harmful insects, to pay for all the peas the birds would be likely to eat in a whole season. The garden where this took place adjoined a small potato field which earlier in the season had been so badly infested with the beetles that the vines were completely riddled. The grosbeaks visited the field every day, and finally brought their fledged young. The young birds stood in a row on the topmost rail of the fence and were fed with the beetles which their parents gathered. When a careful inspection was made a few days later, not a beetle, old or young, could be found; the birds had swept them from the field and saved the potatoes.

It is not easy to advise measures either for increasing the numbers of this bird or inducing it to take up its residence on the farm. Naturally it inhabits thin, open woods or groves, and the change from such places to orchards would be simple—in fact, has already been made in some parts of Pennsylvania and Ohio. In New England the bird is somewhat rare, and perhaps the best that can be done here or elsewhere is to see that it is thoroughly protected.

THE SWALLOWS.

There are seven common species of swallows within the limits of the United States, four of which have, to some extent, abandoned their

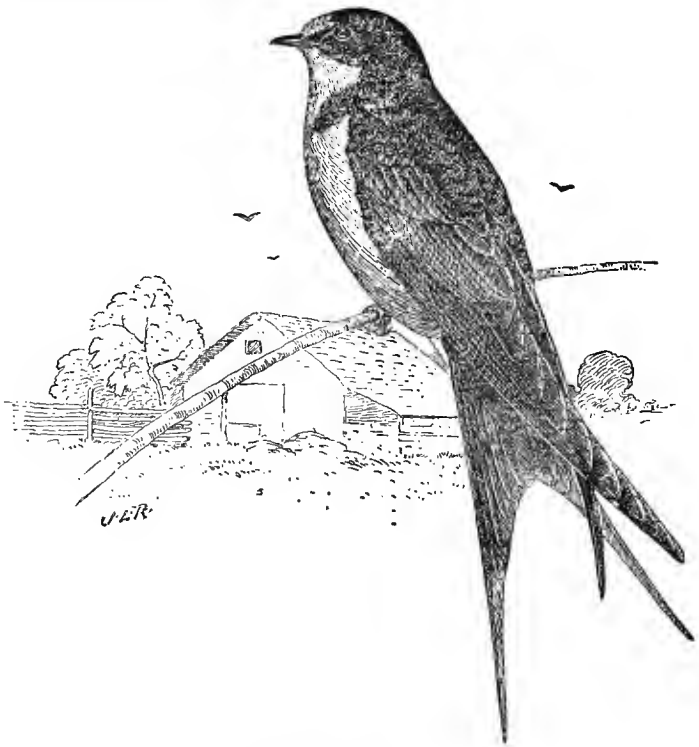


FIG. 16.—Barn swallow.

primitive nesting habits and attached themselves to the abodes of man. As a group, swallows are gregarious and social in an eminent degree. Some species build nests in large colonies, occasionally numbering thousands; in the case of others only two or three pairs are found together; while still others nest habitually in single pairs.

Their habits are too familiar to require any extended description. Their industry and tirelessness are wonderful, and during the day it is rare to see swallows at rest except just before their departure for the South, when they assemble upon telegraph wires or upon the roofs of buildings, apparently making plans for the journey.

A noticeable characteristic of several of the species is their attachment to man. In the eastern part of the country the barn swallow (*Chelidon erythrogastra*) (fig. 16) now builds exclusively under roofs, having entirely abandoned the rock caves and cliffs in which it formerly nested. More recently the cliff swallow (*Petrochelidon lunifrons*) has found a better nesting site under the eaves of buildings than was afforded by the overhanging cliffs of earth or stone which it once used, and to which it still resorts occasionally in the East, and habitually in the unsettled West. The martin (*Progne subis*) and white-bellied swallow (*Tachycineta bicolor*) nest either in houses supplied for the purpose, in abandoned nests of woodpeckers, or in natural crannies in rocks. The other species have not yet abandoned their primitive habitats, but possibly may do so as the country becomes more thickly settled.

Field observation will convince any ordinarily attentive person that the food of swallows must consist of the smaller insects captured in mid-air, or perhaps in some cases picked from the tops of tall grass or weeds. This observation is borne out by an examination of stomachs, which shows that the food consists of many small species of beetles which are much on the wing; many species of Diptera (mosquitoes and their allies), with large quantities of flying ants and a few insects of similar kinds. Most of them are either injurious or annoying, and the numbers destroyed by swallows are not only beyond calculation, but almost beyond imagination.

The white-bellied swallow eats a considerable number of berries of the bayberry, or wax myrtle. During migrations and in winter it has a habit of roosting in these shrubs, and it probably obtains the fruit at that time.

It is a mistake to tear down the nests of a colony of cliff swallows from the eaves of a barn, for so far from disfiguring a building the nests make a picturesque addition, and their presence should be encouraged by every device. It is said that cliff and barn swallows can be induced to build their nests in a particular locality, otherwise suitable, by providing a quantity of mud to be used as mortar. Barn swallows may also be encouraged by cutting a small hole in the gable of the barn, while martins and white-bellied swallows will be grateful for boxes like those for the bluebird, but placed in some higher situation.

THE CEDAR BIRD.

(*Ampelis cedrorum.*)

The cedar waxwing, or cherry bird (fig. 17), inhabits the whole of the United States, but is much less common in the West. Although the great bulk of the species retires southward in winter, the bird is occasionally found in every State during the colder months, especially if wild berries are abundant. Its proverbial fondness for cherries has given rise to its popular name, and much complaint has been made on account of the fruit eaten. Observation has shown, however, that its

depredations are confined to trees on which the fruit ripens earliest, while later varieties are comparatively untouched. This is probably owing to the fact that when wild fruits ripen they are preferred to cherries, and really constitute the bulk of the cedar bird's diet.

In 152 stomachs examined animal matter formed only 13 and vegetable 87 per cent, showing that the bird is not wholly a fruit eater. With the exception of a few snails, all the animal food consisted of insects, mainly beetles—and all but one more or less noxious, the famous elm leaf-beetle being among the number. Bark or scale lice were found in several stomachs, while the remainder of the animal food was made up of grasshoppers, bugs, and the like. Three nestlings were found to have been fed almost entirely on insects.

Of the 87 per cent of vegetable food, 74 consisted entirely of wild fruit or seeds and 13 of cultivated fruit, but a large part of the latter

FIG. 17.—Cedar bird.

was made up of blackberries and raspberries, and it is very doubtful whether they represented cultivated varieties. Cherry stealing is the chief complaint against this bird, but of the 152 stomachs only 9, all taken in June and July, contained any remains of cultivated cherries, and these aggregate but 5 per cent of the year's food. As 41 stomachs were collected in those months, it is evident that the birds do not live to any great extent on cultivated cherries.

Although the cherry bird is not a great insect destroyer, it does some good work in this way, since it probably rears its young mostly upon insect food. On the other hand, it does not devour nearly as much cultivated fruit as has been asserted, and most, if not all, of the damage can be prevented. The bird should therefore be considered a useful species, and as such should be accorded all possible protection.

THE CATBIRD.

(*Galeoscoptes carolinensis.*)

The catbird (fig. 18), like the thrasher, is a lover of swamps, and delights to make its home in a tangle of wild grapevines, greenbriers, and shrubs, where it is safe from attack and can find its favorite food in abundance. It is found throughout the United States west to the Rocky Mountains; occurs also in Washington, Idaho, and Utah, and extends northward into British America. It winters in the Southern States, Cuba, Mexico, and Central America.

The catbird always attracts attention, and the intruder upon its haunts soon understands that he is not welcome. There is no mistaking the meaning of the sneering voice with which he is saluted, and there is little doubt that this gave rise to the popular prejudice against the

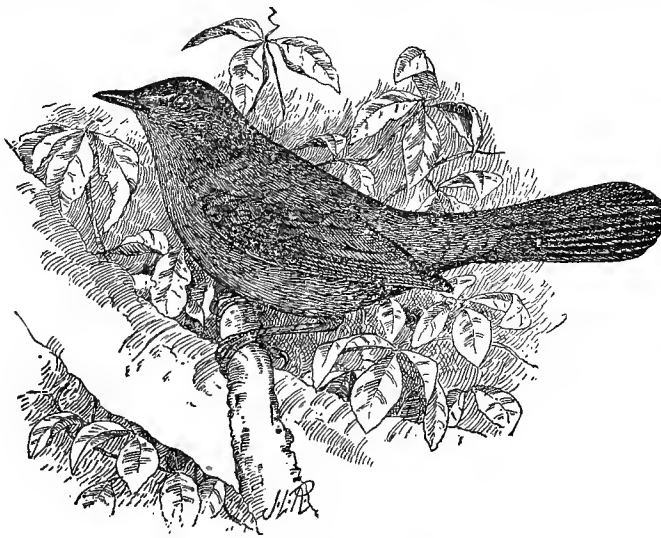


FIG. 18.—Catbird.

bird; but the feeling has been increased by the fact that the species is sometimes a serious annoyance to fruit growers. All such reports, however, seem to come from the prairie country of the West. In New England, according to the writer's experience the catbird is seldom seen about gardens or orchards; the reason may possibly be found in the fact that on the prairies fruit-bearing shrubs which afford so large a part of this bird's food are conspicuously absent. With the settlement of this region comes an extensive planting of orchards, vineyards, and small fruit gardens, which furnish shelter and nesting sites for the catbird, as well as for other species, with a consequent large increase in their numbers, but without providing the native fruits upon which they have been accustomed to feed. Under these circumstances, what is more natural than for the birds to turn to cultivated fruits for their

supplies? The remedy is obvious; cultivated fruits can be protected by the simple expedient of planting wild species or others which are preferred by the birds. Some experiments with catbirds in captivity showed that the Russian mulberry was preferred to any cultivated fruit that could be offered.

The stomachs of 213 catbirds were examined and found to contain 44 per cent of animal (insect) and 56 per cent of vegetable food.[1] Ants, beetles, caterpillars, and grasshoppers constitute three-fourths of the animal food, the remainder being made up of bugs, miscellaneous insects and spiders. One-third of the vegetable food consists of cultivated fruits, or those which may be cultivated, such as strawberries, raspberries, and blackberries; but while we debit the bird with the whole of this, it is probable—and in the eastern and well-wooded part of the country almost certain—that a large part was obtained from wild vines. The rest of the vegetable matter is mostly wild fruit, such as cherries, dogwood, sour gum, elder berries, greenbrier, spice berries, black alder, sumac, and poison ivy.

Although the catbird sometimes does considerable harm by destroying small fruit, the bird can not be considered injurious. On the contrary, in most parts of the country it does far more good than harm, and the evil it does can be reduced appreciably by the methods already pointed out.

THE BROWN THRASHER.

(*Harporhynchus rufus.*)

The brown thrasher (fig. 19) breeds throughout the United States east of the Great Plains, and winters in the south Atlantic and Gulf States. It occasionally visits the garden or orchard, but nests in swamps or in groves standing upon low ground. While it generally prefers a thickly grown retreat, it sometimes builds in a pile of brush at a distance from trees. On account of its more retiring habits it is not so conspicuous as the robin, although it may be equally abundant. Few birds can excel the thrasher in sweetness of song, but it is so shy that its notes are not heard often enough to be appreciated. Its favorite time for singing is the early morning, when, perched on the top of some tall bush or low tree, it gives an exhibition of vocal powers which would do credit to a mockingbird. Indeed, in the South, where the latter bird is abundant, the thrasher is known as the sandy mocker.

The food of the brown thrasher consists of both fruit and insects. An examination of 121 stomachs showed 36 per cent of vegetable and 64 of animal food, practically all insects, and mostly taken in spring before fruit is ripe. Half the insects were beetles, and the remainder chiefly grasshoppers, caterpillars, bugs, and spiders. A few predaceous

[1] The investigation of the food of the catbird, brown thrasher, and house wren was made by Mr. Sylvester D. Judd and published in the Yearbook of the Department of Agriculture for 1895, pp. 405–408.

beetles were eaten, but, on the whole, its work as an insect destroyer may be considered beneficial.

Eight per cent of the food is made up of fruits like raspberries and currants which are or may be cultivated, but the raspberries at least are as likely to belong to wild as to cultivated varieties. Grain, made up mostly of scattered kernels of oats and corn, is merely a trifle, amounting to only 3 per cent, and though some of the corn may be taken from newly planted fields it is amply paid for by the May beetles which are eaten at the same time. The rest of the food consists of wild fruit or seeds. Taken all in all, the brown thrasher is a useful bird, and probably does just as good work in its secluded retreats as

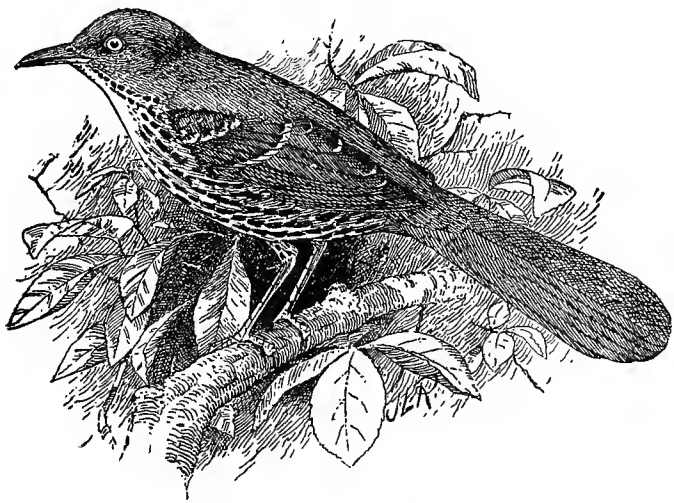


FIG. 19.—Brown thrasher.

it would about the garden, for the swamps and groves are no doubt the breeding grounds of many insects that migrate thence to attack the farmers' crops.

THE HOUSE WREN.

(*Troglodytes aëdon.*)

The diminutive house wren (fig. 20) frequents barns and gardens, and particularly old orchards in which the trees are partially decayed. He makes his nest in a hollow branch where perhaps a woodpecker had a domicile the year before, but he is a pugnacious character, and if he happens to fancy one of the boxes that have been put up for the bluebirds he does not hesitate to take it. He is usually not slow to avail himself of boxes, gourds, tin cans, or empty jars placed for his accommodation.

As regards food habits, the house wren is entirely beneficial. Practically, he can be said to live upon animal food alone, for an examination

of 52 stomachs showed that 98 per cent of the stomach contents was made up of insects or their allies, and only 2 per cent was vegetable, including bits of grass and similar matter, evidently taken by accident with the insects. Half of this food consisted of grasshoppers and beetles; the remainder of caterpillars, bugs, and spiders. As the house wren is a prolific breeder, frequently rearing from twelve to sixteen young in a season, a family of these birds must cause considerable reduction in the number of insects in a garden. Wrens are industrious foragers, searching every tree, shrub, or vine for caterpillars, examining every post and rail of the fence, and every crauny in the wall for insects or spiders. They do not, as a rule, fly far afield, but work

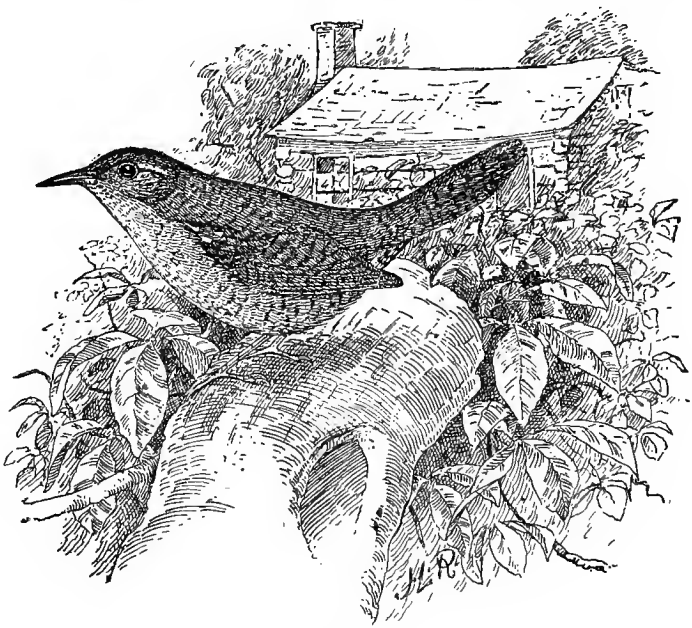


FIG. 20.—House wren.

industriously in the immediate vicinity of their nests. In this way they become valuable aids in the garden or orchard, and by providing suitable nesting boxes they may be induced to take up residence where their services will do most good. Their eccentricities in the selection of a home are well known. Almost anything, from an old cigar box to a tomato can, an old teapot, a worn-out boot, or a horse's skull, is acceptable, provided it be placed well up from the ground and out of reach of cats and other prowlers.

It does not seem possible to have too many wrens, and every effort should be made to protect them and to encourage their nesting about the house.

THE ROBIN.

(*Merula migratoria.*)

The robin (fig. 21) is found throughout the United States east of the Great Plains, and is represented farther west by a slightly different subspecies. It extends far north through Canada, and is found even in Alaska. Although the great bulk of the species leaves the Northern States in winter, a few individuals remain in sheltered swamps, where wild berries furnish an abundant supply of food.

The robin builds its nest in orchards and gardens, and occasionally takes advantage of a nook about the house, or under the shelter of the roof of a shed or outbuilding. Its food habits have sometimes caused apprehension to the fruit grower, for it is fond of cherries and other small fruits, particularly the earlier varieties. For this reason many complaints have been lodged against it, and some persons have gone

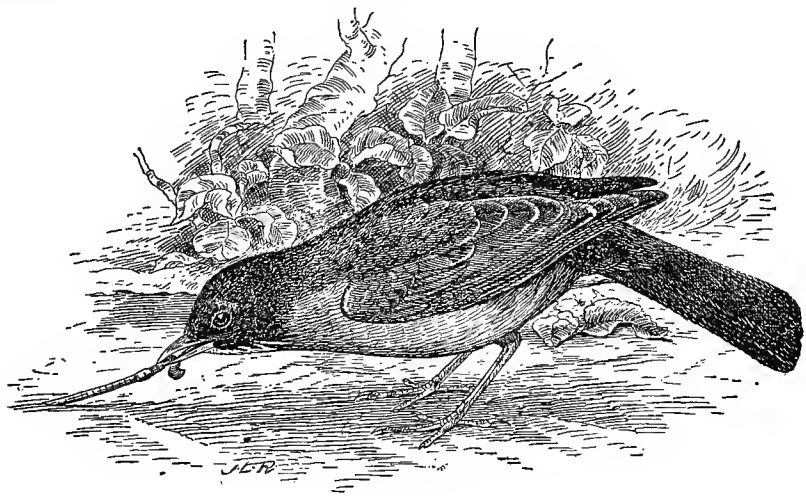


FIG. 21.—Robin.

so far as to condemn the bird. The robin is, however, too valuable to be exterminated, and choice fruit can be readily protected from its depredations.

An examination of 330 stomachs shows that over 42 per cent of its food is animal matter, principally insects, while the remainder is made up largely of small fruits or berries. Over 19 per cent consists of beetles, about one-third of which are useful ground beetles, taken mostly in spring and fall, when other insects are scarce. Grasshoppers make up about one-tenth of the whole food, but in August comprise over 30 per cent. Caterpillars form about 6 per cent, while the rest of the animal food, about 7 per cent, is made up of various insects, with a few spiders, snails, and angle-worms. All the grasshoppers, caterpillars, and bugs, with a large portion of the beetles, are injurious, and it is safe to say that noxious insects comprise more than one-third of the robin's food.

Vegetable food forms nearly 58 per cent of the stomach contents, over 47 being wild fruits, and only a little more than 4 per cent being possibly cultivated varieties. Cultivated fruit amounting to about 25 per cent was found in the stomachs in June and July, but only a trifle in August. Wild fruit, on the contrary, is eaten in every month, and constitutes a staple food during half the year. No less than forty-one species were identified in the stomachs; of these, the most important were four species of dogwood, three of wild cherries, three of wild grapes, four of greenbrier, two of holly, two of elder; and cranberries, huckleberries, blueberries, barberries, service berries, hackberries, and persimmons, with four species of sumac, and various other seeds not strictly fruit.

The depredations of the robin seem to be confined to the smaller and earlier fruits, and few, if any, complaints have been made against it on the score of eating apples, peaches, pears, grapes, or even late cherries. By the time these are ripe the forests and hedges are teeming with wild fruits, which the bird evidently finds more to its taste. The cherry, unfortunately, ripens so early that it is almost the only fruit accessible at a time when the bird's appetite has been sharpened by a long-continued diet of insects, earthworms, and dried berries, and it is no wonder that at first the rich juicy morsels are greedily eaten. In view of the fact that the robin takes ten times as much wild as cultivated fruit, it seems unwise to destroy the birds to save so little. Nor is this necessary, for by a little care both may be preserved. Where much fruit is grown, it is no great loss to give up one tree to the birds; and in some cases the crop can be protected by scarecrows. Where wild fruit is not abundant, a few fruit-bearing shrubs and vines judiciously planted will serve for ornament and provide food for the birds. The Russian mulberry is a vigorous grower and a profuse bearer, ripening at the same time as the cherry, and, so far as observation has gone, most birds seem to prefer its fruit to any other. It is believed that a number of these trees planted around the garden or orchard would fully protect the more valuable fruits.

Many persons have written about the delicate discrimination of birds for choice fruit, asserting that only the finest and costliest varieties are selected. This is contrary to all careful scientific observation. Birds, unlike human beings, seem to prefer fruit like the mulberry, that is sweetly insipid, or that has some astringent or bitter quality like the chokecherry or holly. The so-called black alder (*Ilex verticillata*), which is a species of holly, has bright scarlet berries, as bitter as quinine, that ripen late in October, and remain on the bushes through November, and though frost grapes, the fruit of the Virginia creeper, and several species of dogwood are abundant at the same time, the birds eat the berries of the holly to a considerable extent, as shown by the seeds found in the stomachs. It is moreover a remarkable fact that the wild fruits upon which the birds feed largely are those which man neither gathers for his own use nor adopts for cultivation.

THE BLUEBIRD.

(*Sialia sialis.*)

The common and familiar bluebird (fig. 22) is an inhabitant of all the States east of the Rocky Mountains from the Gulf of Mexico northward into Canada. It winters as far north as southern Illinois, in the Mississippi Valley, and Pennsylvania in the east; in spring it is one of the first migrants to arrive in the Northern States, and is always welcomed as an indication of the final breaking up of winter. It frequents orchards and gardens, where it builds its nest in hollow trees, or takes advantage of a nesting box provided by the enterprising farmer's boy.

So far as known, this bird has not been accused of stealing fruit or of preying upon any crops. An examination of 205 stomachs showed

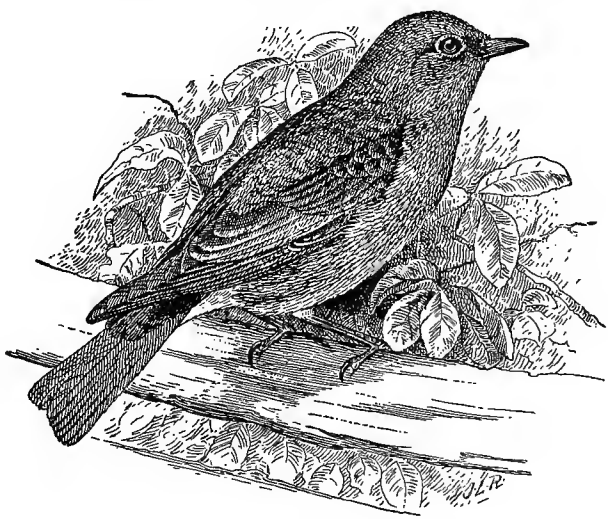


FIG. 22.—Bluebird.

that 76 per cent of the food consists of insects and their allies, while the other 24 per cent is made up of various vegetable substances, found mostly in stomachs taken in winter. Beetles constitute 28 per cent of the whole food, grasshoppers 22, caterpillars 11, and various insects, including quite a number of spiders, comprise the remainder of the insect diet. All these are more or less harmful, except a few predaceous beetles, which amount to 8 per cent, but in view of the large consumption of grasshoppers and caterpillars, we can at least condone this offense, if such it may be called. The destruction of grasshoppers is very noticeable in the months of August and September, when these insects form more than 60 per cent of the diet.

It is evident that in the selection of its food the bluebird is governed more by abundance than by choice. Predaceous beetles are eaten in

spring, as they are among the first insects to appear; but in early summer caterpillars form an important part of the diet, and are replaced a little later by grasshoppers. Beetles are eaten at all times, except when grasshoppers are more easily obtained.

So far as its vegetable food is concerned, the bluebird is positively harmless. The only trace of any useful product in the stomachs consisted of a few blackberry seeds, and even these more probably belonged to wild than cultivated varieties. Following is a list of the various seeds which were found: Blackberry, chokeberry, juniperberry, poke, berry, partridgeberry, greenbriar, Virginia creeper, bittersweet, holly, strawberry bush, false spikenard, wild sarsaparilla, sumac (several species), rose haws, sorrel, ragweed, grass, and asparagus. This list shows how little the bluebird depends upon the farm or garden to supply its needs, and indicates that by encouraging the growth of some of these plants, many of which are highly ornamental, the bird can be induced to make its home on the premises.

Bluebirds are so well known that it seems unnecessary to urge anything more in their favor; but in view of the fact that large numbers were destroyed during the severe storm of 1895, more than ordinary vigilance should be exercised in protecting them until they have regained their normal abundance.

BULLETIN No. 9

U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF BIOLOGICAL SURVEY

CUCKOOS AND SHRIKES

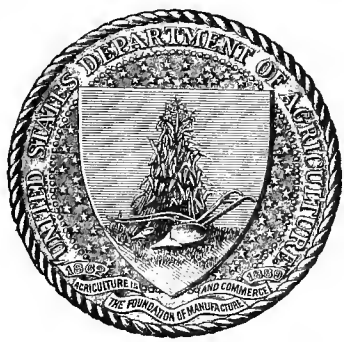
IN THEIR RELATION TO AGRICULTURE

THE FOOD OF CUCKOOS - - By F. E. L. Beal, B. S.
THE FOOD OF SHRIKES - By Sylvester D. Judd, Ph. D.

Prepared under the direction of

Dr. C. HART MERRIAM

CHIEF OF BIOLOGICAL SURVEY



WASHINGTON

GOVERNMENT PRINTING OFFICE

1898

BULLETIN No. 9

U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF BIOLOGICAL SURVEY

CUCKOOS AND SHRIKES

IN THEIR RELATION TO AGRICULTURE

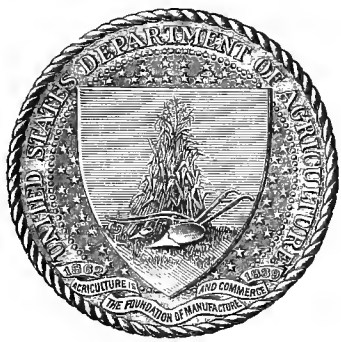
THE FOOD OF CUCKOOS By F. E. L. Beal, B. S.

THE FOOD OF SHRIKES By Sylvester D. Judd, Ph. D.

Prepared under the direction of

DR. C. HART MERRIAM

CHIEF OF BIOLOGICAL SURVEY



WASHINGTON

GOVERNMENT PRINTING OFFICE

1898

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF BIOLOGICAL SURVEY,
Washington, D. C., June 15, 1898.

SIR: I have the honor to transmit herewith, and recommend for publication as Bulletin 9 of this Division, two papers on the food habits of birds, based on investigations conducted in the laboratory of the Biological Survey by Prof. F. E. L. Beal and Mr. Sylvester D. Judd.

Respectfully,

C. HART MERRIAM,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

CUCKOOS AND SHRIKES IN THEIR RELATION TO AGRICULTURE.

THE FOOD OF CUCKOOS.

By F. E. L. Beal, B. S.

GENERAL NOTES.

Cuckoos are quiet and rather shy birds. While they do not avoid the haunts of man, they nevertheless have a way of concealing themselves in foliage, seldom alighting on naked branches or in exposed places, and hence are not often seen. Their favorite resorts are open groves or woods, the edges of forests, orchards, and clumps of trees or shrubs. They often visit shade trees about houses, and are frequently heard in the trees along village streets or even in city parks. In many parts of the country they are known as 'Rain Crows' or 'Kow-kows,' the syllables *kow-kow* being an imitation of their notes.

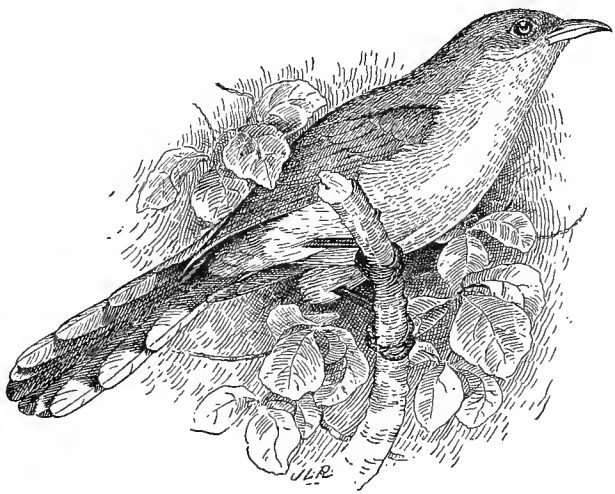


Fig. 1.—Yellow-billed cuckoo.

The cuckoo's nest is usually built in bushes or small trees at no great height from the ground, and is a flimsy affair, composed of a few sticks, forming a mere platform for the eggs, which vary in number from two

to four. The European cuckoo, like our cowbird, lays its eggs in the nests of other birds; a reprehensible habit not shared by its American cousin, although occasional instances of such parasitism have been observed. Our cuckoos do not ostensibly rear more than one brood in a season, but they frequently lay their eggs at intervals, so that the young hatch successively, the later eggs being incubated in part by the young.

Three species and two subspecies occur in the United States. Of these, one species and one subspecies are restricted almost entirely to the southern coast of Florida, and are properly West Indian birds. The others occupy practically the whole country, except the plains and deserts, though in winter they are found in the extreme southern part only. The yellow-billed cuckoo (*Coccyzus americanus*) breeds from the Gulf of Mexico to southern Canada; the black-billed (*Coccyzus erythrophthalmus*) ranges still farther north. The northward migration does not begin until spring is well advanced, and is usually completed by the end of May. Most of the birds leave the Northern States in August, but some linger through September and even into October.

From an economic standpoint cuckoos rank among our most useful birds. Their habit of remaining concealed in foliage suggests, and close observation proves, that their diet consists for the most part of insects—very largely caterpillars—found on trees and shrubs.

EXAMINATION OF STOMACHS.

In the laboratory of the Biological Survey 109 stomachs of the yellow-billed and 46 of the black-billed cuckoo were examined. All were taken between May and October, inclusive, except one of the yellow-billed collected in Texas in January. These stomachs were obtained in twenty States, the District of Columbia, and Canada, and were fairly distributed over the country from Louisiana and Texas to Canada, and from Massachusetts to Kansas and Nebraska. A greater number would have been desirable, but the contents of those examined were so uniform that it seems fair to infer that they give a reasonably accurate idea of the general food of the species. It has been deemed best to treat the two species together, since they prove to be very much alike in diet. The greatest difference is that the yellow-billed cuckoo eats more beetles (Coleoptera) and fewer bugs (Hemiptera). The seasonal variation in diet is much less than in most birds. Of the 155 stomachs of both species examined, only one contained any vegetable food, and this only two berries of the wild rough-leaved cornel (*Cornus asperifolia*). One other stomach contained a bit of rubbish, probably taken accidentally with some insect. Drs. C. Hart Merriam and A. K. Fisher have seen the yellow-billed species feeding on mulberries in Westchester County, N. Y.,[1] and Dr. B. H. Warren found 'berries' in

[1] Annual Report, U. S. Dept. Agriculture for 1890, p. 285, 1891.

one of the nine stomachs examined by him.[1] These observations show that cuckoos do at times eat fruit, but the results of our investigation indicate that it is not their usual habit.

The insect food of cuckoos consists of beetles, grasshoppers, cicadas, bugs, ants, wasps, flies, caterpillars, and spiders, of which grasshoppers and caterpillars constitute more than three-fourths. The great majority of the insects found in the stomachs were harmful kinds. Caterpillars, katydids, and tree crickets are exactly the prey that cuckoos might be expected to secure from their peculiar method of hunting in foliage, while the large numbers of grasshoppers eaten furnish additional proof of the fact so often illustrated that birds are particularly fond of grasshoppers, and that species not naturally ground feeders become so during the grasshopper season.

It is a matter of common observation that cuckoos feed largely on caterpillars, and stomach investigations not only confirm this but show that unlike most other birds they eat freely of hairy and bristly species. Nearly half of the cuckoo's food was found to be caterpillars. An attempt was made to obtain an approximate idea of the actual number in the stomachs by counting the heads and jaws, but in many cases this was nearly impossible, as many of the insects were very young and the jaws consequently minute. The result of this estimate, however, showed that no less than 2,771 caterpillars were contained in 129 stomachs, or an average of more than 21 in each. If the whole number of stomachs (155) is considered, the average is reduced to 18, and it is absolutely certain that this is much below the actual number.

During May and June, when tent caterpillars are defoliating the fruit trees, these insects constitute half of the cuckoo's food. When cuckoos visit the nests of the tent caterpillars they apparently eat as many of the occupants as possible. Most of the stomachs that contained the larvæ at all were filled with them, some having more than 100 individuals. Mr. Otto Lugger, formerly of the Department of Agriculture, examined one stomach which was so full that he concluded that the bird had devoured the whole colony, as there were several hundreds of these hairy caterpillars.

Perhaps the most curious insects found in the cuckoo stomachs were the larvæ of the Io moth. These caterpillars are thickly covered along the back and sides with spines growing from tubercles, which are not only very sharp but poisonous, and sting the hand quite severely when carelessly touched. Nevertheless, they were found in five stomachs, one of which contained seven, another three, and the others one each.

It is noticeable that the larvæ of moths, particularly hawk-moths (*Sphingidæ*), are eaten much oftener than those of butterflies. Whether this comes from preference and selection on the part of the bird or from the greater abundance and more conspicuous habits of the insects

[1] Birds of Pennsylvania, 2d ed., p. 161, 1890.

still remains to be determined. As to the kinds of caterpillars eaten, it may be said that the hairy and spiny species far outnumber the smooth, but this may be due either to the greater abundance of the hairy ones or to the bird's preference.

This diet of hairy caterpillars has a curious effect upon the birds' stomachs. A cuckoo's stomach, unlike that of seed-eating species, has only a thin muscular coat on the outside, and the usual smooth lining is almost entirely devoid of rugæ or folds so characteristic of the stomachs of many birds. This inner layer is almost always found pierced by at least a few caterpillar hairs; often by so many as to be completely furred and the membrane itself almost entirely concealed. Incidentally this hairy lining affords an excellent means of determining the motion of the food during digestion. If a stomach is divided in the plane of its two greater diameters the hairs on each half will be found brushed around a center like the nap on the top of a silk hat, indicating that the whole mass of food revolves in this plane. It may also be noticed that the skins of caterpillars taken from the stomachs of birds are always twisted like a cord or rope, and often require considerable untwisting before their characters can be determined.

In a review of the food of cuckoos the most striking point is the great number of caterpillars or lepidopterous larvæ which enter into the year's diet. These insects are crude feeders, eating immense quantities of vegetable tissue, and are usually so distended with it that the amount of real nutrition in any one of them must be small. In fact, stomachs of birds that have eaten largely of caterpillars always show a quantity of this finely cut vegetable matter derived from the insects' stomachs. As digestion in birds is rapid it would seem necessary to fill the stomach several times a day with such quickly digested and slightly nutritious food as this, while the number of caterpillars found in a stomach at any one time probably represents but a small portion of the actual daily consumption. From these considerations it appears that cuckoos must eat an enormous number of larvæ in the course of a season. If the contents of all the stomachs examined are regarded as so many daily meals of the same bird, then the result indicates that the bird has eaten 2,771 caterpillars in 155 consecutive days, at the rate of only one meal each day, and some days not eating any. Now, 155 days is about the length of time that cuckoos remain in their summer range; moreover, as indicated above, one cuckoo must eat several meals a day, so this number (2,771) probably falls far short of the actual number of caterpillars devoured by each cuckoo during the season.

In view of such considerations it seems hardly possible to overestimate the value of the cuckoo's work. All caterpillars are harmful, many of them are pests, and any of them are likely to become so. The common tent caterpillar formerly fed upon the wild cherry, but has now turned its attention principally to apple trees, sometimes com-

pletely defoliating them. What this caterpillar has done, many others may do. In the cuckoos we probably have one of nature's most efficient checks on the increase of these harmful species. It is said that hairy caterpillars are protected by their coats from the attacks of the ichneumon flies; if this be true, the work of the cuckoos in destroying the hairy species is complementary to that of the ichneumons, which help to destroy the smooth-coated caterpillars. Considering the number of grasshoppers, locusts, and other insects that cuckoos eat in addition to caterpillars, it is evident that from an economic point of view these birds are two of our most valuable species, and as they have not been convicted of doing any harm, they should be protected and encouraged in every possible way.

Besides insects proper, a number of spiders were found in the stomachs examined, most of them the long-legged kinds commonly known as 'daddy longlegs' or harvestmen (*Phalangidæ*). One stomach contained seven, the mass of tangled legs looking like a bunch of coarse hair. When we consider the disgusting odor of these spiders, their long legs, and the fact that their bodies have the texture of sandpaper, we are again forcibly reminded that tastes differ. But the most remarkable thing which the cuckoos had eaten was a small tree frog (*Hyla*) which had been swallowed whole!

In view of Audubon's accusation that the yellow-billed cuckoo sucks the eggs of other birds, it may be said that eggshells were found in several stomachs taken in July and August, but only in very small quantities—no more than found in the stomachs of nearly every species that has been examined. It is probable that these were merely empty shells eaten for the sake of the lime they contained. It may be added that one stomach disclosed a snail shell, which was probably taken for the same purpose. A number of stomachs contained each from one to three bits of gravel, but why the stones were swallowed was not apparent. Cuckoos do not eat hard seeds, and even if they did their stomachs are not muscular enough to act as a mill for grinding, as are those of gallinaceous and fringilline birds.

GENERAL INSECT FOOD OF CUCKOOS.

BEETLES.

The beetles found in the stomachs belong to several families, no one of which forms any important percentage of the total food. The stomach taken in Texas in January contained 17 percent of beetles belonging to five different families, all harmful. Beetles constitute 14 percent of the food in May, but later in the season decrease, and after July practically disappear. The useful *Carabidæ* are rarely eaten, which is easily explained by the fact that they live on the ground, while the cuckoos feed mainly in trees. One bird, however, had eaten a specimen of *Calosoma scrutator*, one of the largest and most predatory of these beetles,

which, it may be added, is one of the most disgusting in odor. This was probably the most useful insect that the birds had eaten. *Scarabæidæ* were somewhat more numerous than other beetles. The most noticeable of these was the goldsmith beetle (*Cotalpa lanigera*), which was found in 3 instances—6 specimens in one stomach and 3 in each of the others. Two stomachs contained each 2 specimens of the Colorado potato beetle (*Doryphora 10-lineata*). *Elateridæ*, *Buprestidæ*, *Tenebrionidæ*, *Cerambycidæ*, *Lampyridæ*, and a few *Rhynchophora*, or snout beetles, were also found. Among the latter was 1 specimen of the rice weevil (*Calandra oryzæ*). Altogether beetles constitute a little more than 6 percent of the year's food.

BUGS (HEMIPTERA).

Hemiptera, or bugs, are represented by cicadas, pentatomids, and a few others. The great bulk is made up of cicadas, or dog-day harvest flies, which seem to be a favorite article of food, as no less than 5 were found in one stomach and 4 in another. Stink-bugs (*Pentatomidæ*) were found in quite a number of stomachs, but not in large quantities. A few assassin bugs (*Reduviidæ*) were also detected. No Hemiptera were contained in the stomachs collected in January, but in the May stomachs they amount to 12 percent, and do not vary much until after August, when they begin to disappear. They amount to about 6½ percent of the food of the year.

GRASSHOPPERS (ORTHOPTERA).

The Orthoptera eaten by the cuckoos consist of common grasshoppers, katydids, and tree crickets. The common grasshoppers are evidently favorites, as is the case with so many other birds. Several stomachs contained from 10 to 20 of these insects—a good meal for so small a bird. Katydids and their eggs were found in many stomachs, and often several individuals in a single stomach. The snowy tree cricket (*Œcanthus niveus*) is another insect that would seem naturally to fall in their way, and which their stomachs prove that they often eat. Orthoptera collectively were found in 86 of the 155 stomachs examined, and constitute about 30 percent of the year's food. Beginning with about 3 percent in May, they increase to over 43 percent in July, and do not fall much below this point during the remainder of the year.

CATERPILLARS.

Nearly half of the yearly food (48.5 percent) consists of caterpillars, which were found in 129, or 83 percent, of the 155 stomachs examined. The stomach taken in January contained 15 percent; in May the percentage rose to 60; in July and August it fell off a little to make room for grasshoppers, and in September reached the maximum of 75.

One of the most conspicuous and interesting of these larvæ is the

common tent caterpillar (*Clisiocampa americana*), which was recognized in 17 stomachs, and was almost certainly contained in many more, though the remains were too fragmentary for positive identification. When it is considered that this species can be obtained only during May and June and that only 50 stomachs were collected in these months, it will be seen that more than one-third of all the birds that could get these insects had eaten them. Though the remains in many stomachs could not be identified with certainty, there is no reasonable doubt that these caterpillars constitute at least half of all the food during this period.

Another caterpillar which appears very frequently in the cuckoo's diet is the destructive fall web-worm (*Hyphantria cunea*). In one stomach 217 heads of this insect were counted, and the fragments of others indicated that 250 would be nearer the correct number. The larvæ of the white-marked tussock moth (*Orgyia leucostigma*) are also frequently eaten. One stomach contained remains of a number of army worms (*Leucania unipuncta*), but as these caterpillars feed upon grass, grain, and other plants that grow in the open, they do not naturally fall in the way of cuckoos. It is probable that army worms would be more extensively eaten if the fields infested with them were in the immediate vicinity of woods. Besides eating caterpillars of ordinary size, cuckoos often indulge in a meal of the larvæ of the larger moths and hawk moths. Of the latter, *Protoparce carolina* and *Deilephila lineata* were found in several stomachs. In fact, sphingid larvæ appear to be favorites, and make up a large proportion of the hairless caterpillars eaten. Giant silkworms were represented by one larva of *Telea polyphemus*, the Io moth (*Hyperchiria io*) by 13 larvæ, and royal moths by 1 of *Eacles imperialis*, each as large as a man's finger. Only 3 butterfly larvæ were identified, one the black spiny larva of *Vanessa antiopa*, another the well-known *Limenitis disippus*, the third the larva of a skipper, *Eudamus tityrus*. While cuckoos eat many larvæ of Lepidoptera, remains of the adult insects were found only once. In this case the stomach contained the heads of several small moths of the *Arctiidæ*, a family whose larvæ are hairy.

MISCELLANEOUS INSECTS.

A little more than 5 percent of the food is made up of miscellaneous insects, consisting of Diptera, Hymenoptera, and a few others. Tipulids, or crane flies, constitute the greater part of the Diptera; they are found in quite a number of stomachs, but do not amount to much in bulk. Among the Hymenoptera, the most interesting, as well as those most frequently found, are larvæ of sawflies (*Tenthredinidæ*). These so closely resemble caterpillars that entomologists call them 'false caterpillars'; and it seems probable that this resemblance explains why the cuckoo eats them. They do not, however, appear distasteful, for one bird had eaten over 60. Larvæ of our largest species of sawfly (*Cimbex*

americana) were found in several stomachs. Ants, too, are frequently eaten; probably captured when crawling over leaves or branches—possibly when tending their dairies of plant lice. One stomach from western Pennsylvania, taken on June 2, contained, among other insects, 2 curious heads of ants, which were identified by Mr. Pergande, of the Division of Entomology, as belonging to the genus *Cryptocarus*. This genus is not known from the United States, but is abundant in Mexico and the West Indies. The bird was probably a late migrant. A few other Hymenoptera were found, among them a specimen of that curious long-bodied creature, *Pelecinus polyturator*. In the stomachs examined a few dragon flies were detected, but not enough to constitute a perceptible percentage. There were also some spiders, mainly *Phalangidæ*.

As a matter of interest to the entomologist, as well as the ornithologist, a list of insects identified in the cuckoos' stomachs is appended:

INSECTS IDENTIFIED IN THE STOMACHS OF CUCKOOS.

Coleoptera:
- Calosoma scrutator.
- Lachnosterna sp.
- Osmoderma sp.
- Cotalpa lanigera.
- Gnorimus maculosus.
- Euphoria melancholica.
- Dichelonycha sp.
- Lucanus sp.
- Sandalus petrophya.
- Lina scripta.
- Disonycha abbreviata.
- Chrysomela scalaris.
- Doryphora 10-lineata.
- Romaleum atomarium.
- Prionus sp.
- Leptura sp.
- Buprestis sp.
- Chauliognathus sp.
- Phytonomus nigrirostris.
- Tyloderma æreum.
- Pissodes sp.
- Calandra oryzæ.
- Cratoparis lunatus.

Hemiptera:
- Brochymena sp.
- Enschistus sp.
- Nezara hilaris.
- Cicada pruinosa.
- Cicada tibicen.

Orthoptera:
- Œdipoda sp.
- Pozotettix sp.
- Ceuthophilus sp.
- Œcanthus nivens.

Lepidoptera:
- Anisota senatoria.
- Anisota virginiensis.
- Alypia octomaculata.
- Acronycta americana.
- Hypercbiria io.
- Eacles imperialis.
- Clisiocampa americana.
- Cerura sp.
- Datana ministra.
- Datana contracta.
- Dryocampa rubicunda.
- Deilephila lineata.
- Eudryas unio.
- Edema albifrons.
- Heterocampa manteo.
- Hyphantria cunea.
- Leucania unipuncta.
- Nadata gibbosa.
- Notodonta sp.
- Orgyia leucostigma.
- Psychomorpha epimenis.
- Smerinthus sp.
- Protoparce carolina.
- Spilosoma virginica.
- Telea polyphemus.
- Eudamus tityrus.
- Vanessa antiopa.
- Limenitis disippus.

Hymenoptera:
- Pelecinus polyturator.
- Lophyrus sp.
- Cimbex americana.
- Camponotus sp.
- Cryptocarus sp.

THE FOOD OF SHRIKES.

By SYLVESTER D. JUDD, Ph. D.

HABITS OF SHRIKES.

Two species of shrikes inhabit North America. One, the loggerhead shrike (*Lanius ludovicianus et subspec.*), is a permanent resident in the United States; the other, the butcherbird (*Lanius borealis*), visits us from the north in winter. Either might be mistaken for a mocking bird, but upon close inspection is seen to have the hooked beak of a hawk; instead of possessing talons, however, it has weak and slender feet, thus combining characters of a bird of prey with those of a song bird.

During cold weather the shrike in wait for prey takes his stand on some high perch that commands a wide view. In this position he watches, ready to pounce on the first bird that twitters in the briers, or mouse that rustles in the grass. When the quarry has been secured, it is carried to a sharp twig or thorn and spitted, and then the hunter, ever eager to satisfy his desire for the chase, goes off to the hedgerows to search for more game. In Germany it is said that a closely allied species daily kills and impales nine victims, from which belief came the common name '*Neuntödter*' or Ninekiller. It is well known that the shrike kills and hangs up in his shambles more than he can utilize. But this apparently wanton slaughter may often be the salvation of many a shrike whose hunt over snow-covered fields has yielded no return.

This habit of impaling its prey is well described by Mr. Benjamin Mortimer who, in writing from Orange, Fla., says:

> In March, 1889, two instances of the loggerhead shrike's killing smaller birds came under my notice. In both cases the victim was a grasshopper sparrow, although birds of this species were few and scattered at that time, while the savanna sparrow was very abundant. The sparrows were impaled by the neck upon orange thorns, and there were no wounds on any other part of the body. * * * This bird (the shrike) impales its prey not only when it wishes to preserve it, but also when it intends to devour it immediately, and the long slivers on fresh pine stumps are commonly selected for the purpose wherever they can be found. The bird flies to a stump with its victim, usually a beetle, and forces it upon a sliver, just behind the thorax, thus having a convenient place to stand and a convenient fork to hold the morsel while he breaks open the hard shell and eats the softer parts. The same stump is resorted to many times by the same bird, so that it is common to find quantities of the legs and wing cases of beetles about these curious dining tables.

The habit of killing small animals and hanging up their bodies has given the shrike the appropriate generic name *Lanius*, which means 'butcher.' The name 'Butcherbird' is more properly applied to the larger northern bird, while to the smaller and more southerly species the title 'Loggerhead' shrike is given.

Different diets affect in time the structure of an animal. Special parts are developed for procuring and digesting food. But the rôle that food habits play in the production of such variations has not yet been fully worked out. All structures are necessarily developed and maintained in direct relation to function. Shrikes have special structures suited to their peculiar feeding habits. So long as the northern shrike or butcherbird is restricted to an animal diet, because of the relative scarcity of insects at the North during most of the year, it must be more of a meat eater than its southern cousin, the loggerhead. The struggle for existence in the North is so keen that the butcherbird, during cold weather, must hold itself in readiness to fly at the first bird or mouse that is sighted.

The food habits of the shrikes, so far as determined from the examination of 155 stomachs, collected during every month of the year, from Saskatchewan to Florida and from the Atlantic to the Pacific, are very similar to those of the sparrow hawk; that is to say, the food consists of mice, small birds, and insects, the latter mainly grasshoppers. Both birds are much less insectivorous in cold than in warm weather—the oncoming of winter and consequent increasing scarcity of insects necessitating a change in food.

In discussing the insectivorous habits of the shrike, it is hardly necessary to state that the destruction of grasshoppers is a great service to the farmer. The shrike also devours a large number of beetles, and often eats caterpillars, wasps, and spiders. Since it takes practically no vegetable food, it can not injure crops, unless indirectly, by killing birds and insects that prey upon insect pests. The birds selected, however, are for the most part seed eaters and consequently less valuable than the insectivorous kinds; and if it be granted that the harm done by the destruction of one of these birds is counterbalanced by the killing of one mouse, then it follows that the harm done by the shrike in killing birds is completely offset. Furthermore, the attacks of the shrike are often directed against the English sparrow, now so obnoxious in many parts of the United States. Concerning the insect food, it may be safely stated that the percentage of noxious grasshoppers is four times as great as that of the useful ground beetles.

In considering the relation of the shrikes to agriculture, it must be remembered that one inhabits a fertile country where cultivation yields heavy crops, while the other lives in a northern region where agriculture amounts to very little. Therefore, the good or harm done by the northern butcherbird must be mainly accomplished when it migrates south into the United States. From the present limited investigation, it

appears that the beneficial qualities of both shrikes outweigh the injurious. Furthermore, it is probable that when it is possible to study the summer food habits of the butcherbird, this species, like its southern relative, the loggerhead, will be found to be a destroyer of quantities of grasshoppers and other noxious insects.

NORTHERN SHRIKE OR BUTCHERBIRD.

The northern shrike is a bird of the Hudsonian zone, breeding from Labrador to Alaska, and visiting the United States in winter only, when its food supply fails at the North. During its winter sojourn it renders a threefold service by killing grasshoppers, English sparrows, and mice. The birds and mice together amount to 60 percent, and insects to 40 percent, of the food from October to April. Grasshoppers constitute one-fourth of the food, and are equal to twice the combined amounts of beetles and caterpillars.

Apparently no mineral or vegetable matter is intentionally swallowed. Indeed, its exclusively animal diet makes it, practically, a bird of prey, and therefore we must consider what animals it destroys.

BIRDS EATEN BY THE BUTCHERBIRD.

The Chippewa Indians call this shrike 'big cannibal bird,' and several instances of cannibalism are recorded. In one case a hungry butcherbird pounced upon and carried off his companion, which had been shot and laid on the top of a log cabin. The butcherbird, when impelled by extreme hunger, becomes very bold, and has been known to enter a room and decapitate a caged canary.

In the stomachs of the 67 butcherbirds examined 28 species of seed-eating birds were found. Of these 3 were tree sparrows, 5 juncos, and 7 English sparrows; the others could not be named with certainty. The tree sparrows and juncos were found in shrikes that had been taken in rural districts. On the other hand, English sparrows were found only in stomachs of birds that had been collected in cities.

In speaking of the enemies of the English sparrow, Prof. W. B. Barrows says:

> Probably the most useful bird in this respect is the northern shrike (*Lanius borealis*), which visits most of our northern cities in winter and feeds freely on the sparrow. At one time this shrike became so abundant on the Common and public parks in Boston that it threatened to destroy all the sparrows, but the shortsighted authorities kept a man busy shooting the shrikes, until several dozen had been killed, and the useless sparrows were considered safe.

It is to be hoped that in other cities this enemy of the sparrow will be protected instead of persecuted. If there were 6 butcherbirds in each of 20 New England cities, and each butcherbird killed 1 sparrow a day for the three winter months, the result would be a removal of 10,800 sparrows. Since 2 sparrows could raise under favorable conditions four broods of 5 each, the increase would be tenfold, so that those

destroyed by the butcherbirds, if allowed to live, would have amounted at the end of the first year to 118,800, and at the end of the second year to 1,306,800 individuals. The shrike is at work every winter in the cities of the northern tier of States, killing the sparrows which tend to increase until they become so abundant that more are obliged to resort to the country for food. In a number of instances where English sparrows had been devoured, their stomachs, containing seeds and gravel, were found within the butcherbirds' stomachs. A golden-crowned kinglet's stomach also was detected, filled with fragments of a beetle and scores of tiny gnats. Mr. Frank M. Drew, in an article entitled 'Field Notes on the Birds of San Juan County, Colorado' (Bull. Nutt. Ornith. Club, vol. 6, p. 89), says that this shrike lives by foraging on little troops of titmice. Dr. G. S. Agersborg, of South Dakota, states (The Auk, vol. 7, p. 279) that it seems to follow the wake of the tree sparrows (*Spizella monticola*), and leaves in the spring at the same time they do. Prof. F. E. L. Beal while at Ames, Iowa, noted the butcherbird attacking birds only once, although he had time and again recorded their killing mice. In this exceptional case the victim was a downy woodpecker (*Dryobates pubescens*) which the shrike had hung in a crotch while devouring the brains. The most remarkable account of the butcherbird's not molesting birds also comes from Professor Beal at the same station. A shrike was perched on a telegraph wire above a rank weed patch which was all a-twitter with hundreds of native sparrows. Every now and then the shrike would leave the wire to scour the prairie, apparently hunting for mice, and then return to his perch. He paid no attention to the sparrows, and they showed no signs of apprehension.

Following is a list of birds that the butcherbird has been known to kill:

Chickadee (*Parus atricapillus*).[1]
Bush tit (*Psaltriparus*).
English sparrow (*Passer domesticus*).[2]
Tree sparrow (*Spizella monticola*).[2]
Snowflake (*Plectrophenax nivalis*).
Downy woodpecker (*Dryobates pubescens*).
Vireo (*Vireo* sp.).
Junco (*Junco hyemalis*).[2]
Kinglet (*Regulus satrapa*).[2]
Field sparrow (*Spizella pusilla*).[2]
Goldfinch (*Spinus tristis*).[2]
Siskin (*Spinus pinus*).[2]
Yellow-rumped warbler (*Dendroica coronata*).[2]
Mourning dove (*Zenaidura macroura*).
Cardinal (*Cardinalis cardinalis*).
Longspur (*Calcarius*).[3]
Shore lark (*Otocoris*).[3]

[1] Dr. J. Dwight, jr.
[2] Identified in the laboratory.
[3] Ornithologist and Oologist.

MAMMALS EATEN BY THE BUTCHERBIRD.

The stomach of a shrike that has recently eaten a mouse is found to be filled with a large ball of fur, with bones in the center. It is impossible for these large masses to pass through the small intestine, therefore they are expelled through the mouth. A number of birds, including the European shrike (*Lanius excubitor*), are known to disgorge pellets after the manner of birds of prey.

Mice were found in one-third of the stomachs examined, constituting one-fourth of the food, and were eaten most frequently in March. Of these mice 15 were identified as follows: 1 white-footed mouse (*Peromyscus*), 1 harvest mouse (*Reithrodontomys*), and 8 meadow mice (*Microtus*). This last mouse is the one that oftenest falls a victim to hawks and owls. Mr. William Brewster, of Cambridge, Mass., states in The Auk (Vol. XI, p. 329) that he saw a shrike seize a large meadow mouse by the back, drag it across the snow, and then drop it. The mouse, instead of trying to escape, sprang at the shrike and drove it back several feet. Finally the bird, by several well-aimed passes, succeeded in intimidating the mouse, and then, as the latter turned to run away, caught it by the neck and worried it to death, as a terrier would a rat. The mouse was afterwards borne off in the shrike's claws and fixed in the fork of a tree. Meadow mice, besides consuming grass and grain, also girdle fruit trees, and the house mouse, in addition to wasting corn in the granary, wantonly destroys grain standing in the shock.

Dr. E. A. Mearns, United States Army, states in a letter that shrikes in Minnesota during March live exclusively upon meadow mice (*Microtus*), and Mr. W. L. Scott (The Auk, Vol. I, p. 158) cites an instance in which a butcherbird was caught in the act of giving chase to a chipmunk (*Tamias striatus*).

Carrion is sometimes eaten. Prof. F. E. L. Beal, while at Ames, Iowa, in January, 1880, saw a butcherbird fly over the brown frozen prairie to a carcass of a cow, where it lit on one of the ribs and greedily tore off shreds of the flesh.

INSECTS EATEN BY THE BUTCHERBIRD.

Active insects are much more liable than sluggish ones to fall victims to the butcherbird, because objects which at rest can not be discriminated are instantly seen when moving. Thus it happens that flying grasshoppers and running beetles form a large proportion of the food of this bird. Grasshoppers and crickets (*Orthoptera*), which are eaten during every month from October to April, form 24 percent of the total volume of food, and for October and November together these insect pests form more than half of the food. Compared with *Orthoptera*, the beetles (*Coleoptera*) eaten are of minor importance, amounting to only 6 percent of the food. More than half these beetles belong to the family *Carabidæ*, the members of which prey upon insect pests. Cater-

pillars were contained in one-fifth of the stomachs examined, and during the months of January and February amount to 8 percent of the volume of the stomach contents. Dr. A. K. Fisher collected in March two stomachs that were full of caterpillars. Even the bristly Isabella caterpillar is eaten, an object apparently as edible as a chestnut bur. Cutworms were found in several instances, but moths were seldom met with. Ants, wasps, flies, and thousand legs are sometimes eaten, and spiders constitute 3 percent of the food; but bugs (*Hemiptera*) were not detected during our laboratory investigations, though a cicada supposed to have been impaled by a shrike was found by Mrs. Musick, at Mount Carmel, Mo.

Important as is the study of the food of nestlings, it must, for lack of material, rest on the work of other writers. Audubon states that caterpillars, other insects and spiders, together with small fruits, form the first food of young butcherbirds. It seems odd that a bird which eats no fruit itself should feed its young on berries. The loggerhead shrike, as far as my investigation shows, neither takes vegetable food nor gives it to its young; and furthermore, our fruit-eating birds, so far as known, never begin by feeding their young on fruit.

The present investigation shows that beneficial birds form less than one-fourth of the food of the butcherbird. It also shows that the butcherbird, in addition to being an enemy of mice, is a potent check on the English sparrow, and on several insect pests. One-fourth of its food is mice; another fourth grasshoppers; a third fourth consists of native sparrows and predaceous beetles and spiders, while the remainder is made up of English sparrows and species of insects, most of which are noxious.

THE LOGGERHEAD SHRIKE.

The geographic races of the loggerhead shrike have almost identical habits, and consequently will be considered together. During the breeding season the loggerhead, the southern representative of the butcherbird, inhabits the United States, northern Mexico, and the southern part of the interior of Canada. It is smaller and differs in minor details of color: the lower mandible is black, while that of the butcherbird is yellowish; and the black bars on the side of the head meet across the forehead, but fail to do so in the butcherbird. In fall the loggerheads wander southward, but in spring they return to their breeding grounds and nest in thorny shrubs.

BIRDS EATEN BY THE LOGGERHEAD.

Only 7 birds were found in the 88 loggerhead stomachs examined. One of these was an English sparrow, another a tree sparrow, and most of the others, which were not specifically identified, were also seed-eating birds.

Following is a list of birds reported to have been killed by the loggerhead:

English sparrow (*Passer domesticus*).
Tree sparrow (*Spizella monticola*).
Yellow-winged sparrow (*Ammodramus savannarum passerinus*).
Song sparrow (*Melospiza fasciata*).
Western chipping sparrow (*Spizella socialis arizonæ*).[1]
White-throated sparrow (*Zonotrichia albicollis*).[2]
Young chicken.[3]
Canary (*Serinus canarius*).[4]
Chimney Swift (*Chætura pelagica*).[4]
Ground dove (*Columbigallina passerina terrestris*).
Bell's vireo (*Vireo belli*).[1]
Snow bunting (*Plectrophenax nivalis*).[5]
Blue-gray gnatcatcher (*Polioptila cærulea*).[1]

MAMMALS EATEN BY THE LOGGERHEAD.

From the laboratory investigation there is no evidence to show that shrews are eaten, but Mr. Robert Ridgway has seen shrews that had been impaled by the loggerhead. Mice are often found in stomachs of birds killed in winter, at which season they form 50 percent, and for the whole year 16 percent, of the food. The pretty white-footed mice are favorites. Bones, skin, and two tails of this mouse were taken from one stomach. The loggerhead is a good mouser during cold weather, but owing to its weaker bill is not so successful as the butcherbird in its battles with the large meadow mice.

Cases have been recorded where loggerheads ate carrion. Mr. William Lloyd, in an article entitled 'Birds of Tom Green and Concho counties, Texas' (The Auk, Vol. IV, 1887, p. 295), states that in the severe January of 1884 he found a loggerhead shrike so gorged from feeding on a dead sheep that it could not fly.

OTHER VERTEBRATES EATEN BY THE LOGGERHEAD.

Lizards were found in 6 of the 9 stomachs collected south of the latitude of Nashville, Tenn. One of the lizards was the so-called chameleon (*Anolis principalis*). Snakes, fish, and frogs are occasionally eaten. On this subject Mr. H. G. Gedney writes: * * * "I have often seen them (loggerheads) return to lizards and tree toads which they had impaled * * *. I saw a loggerhead attack a snake of the genus *Leptophis*, nearly two feet long, and after a sharp contest succeed in dispatching it." It is not at all uncommon for loggerhead shrikes to kill snakes. In The Osprey for April, 1897, is a picture of an impaled garter snake (*Eutænia sirtalis*) beside a loggerhead's nest, and several observers have told me that they attack snakes and impale their bodies. Prof. W. G. Johnson, of the Maryland Agricultural College,

[1] William Lloyd.
[2] William Palmer.
[3] Florida Dispatch.
[4] Robert Ridgway.
[5] W. H. Collins.

has observed the loggerhead impale snakes on a barbed-wire fence. At times loggerheads feed upon fish. The stomach of a bird killed in Utah on a cold winter's day contained nothing but minnow's bones; and Bachman speaks of the shrike's impaling fish that have been left by fishermen.

INSECTS EATEN BY THE LOGGERHEAD.

The larger part of the insect food of this shrike consists of *Orthoptera* (grasshoppers and crickets), and the remainder is principally beetles. In summer, when grasshoppers are abundant, the loggerhead does not seem to attack birds. The fact that in time of plenty more insects are killed and impaled than can be utilized indicates that the percentage of these pests destroyed is much greater than the laboratory examinations show. The same statement would not hold good in the case of the destruction of birds, because during cold weather when birds are killed there is a scarcity of food, and all the spoils of the chase are probably utilized. Grasshoppers and crickets were found in three-fourths of the stomachs examined, and 14 of the 88 shrikes had fed exclusively upon these pests. Most of the *Orthoptera* eaten are grasshoppers, though some crickets are taken. Most of the grasshoppers found in stomach contents are flying species, among which have been noted the dust-colored *Dissosteira carolina* which, when rising from the road, shows beautiful yellow underwings, and the red-legged grasshopper (*Melanoplus femur-rubrum*) which is so conspicuous in hay fields. The pellucid grasshopper (*Camnula atrox*), which is somewhat migratory, is frequently captured, and also an ugly grasshopper (*Hippiscus*). In Arizona Dr. Horn has seen loggerheads catch grasshoppers and impale them on cactus spines. One of the largest insects devoured by this bird is a sand cricket, the so-called Idaho devil. The mole cricket, likewise a large insect, is attacked and eaten by the shrikes of the southeastern United States. The fact that they take these enormous insects shows that whatever food becomes available in any locality is generally utilized.

Beetles and their larvæ are found in about one-fourth of the stomachs, and constitute 20 per cent of the bulk of the food. Most of the beetles are eaten in spring before grasshoppers become abundant. Half the beetles and their larvæ destroyed are useful carnivorous species that prey upon insect pests. Some of the largest of these beneficial beetles have been found stuck upon the splinters of the stump of a felled tree. There were taken from one loggerhead's stomach 112 jaws of the larvæ of a large predaceous beetle, and from another stomach the remains of the useful tiger beetle. It is probable that the killing of useful beetles is more detrimental to agricultural interests than the destruction of birds. Although half the beetles eaten are beneficial, most of the others are injurious. Among this latter class may be mentioned large, bright-colored, wood-boring bee-

tles (*Buprestidæ*), with the adult beetles of wire worms, weevils, and some allies of the May beetle. There are also eaten some of the harmless species closely related to this last group of beetles, as for instance the little dung beetles (*Aphodius*) and the large green-and-gold tumblebug (*Phanæus carnifex*). Darkling (*Tenebrionidæ*) and carrion beetles (*Silphidæ*) are frequently caught, and the latter insects have been found stuck upon a barbed-wire fence.

The insect food of the loggerhead, like that of the butcherbird includes about 11 percent of caterpillars, wasps, and spiders. In the stomach of one bird was the abdomen of a large wasp with its sting still attached. That the loggerhead is given to catching large insects is shown by the fact that one stomach was distended with a large grasshopper (*Schistocerca americana*), another contained a mole cricket, and a third was filled with an enormous saw fly (*Urocerus*). This last wasp-like insect does much damage by puncturing trees, thus making an opening for wood-boring insects.

Loggerheads relish caterpillars; they destroy canker worms (*Geometridæ*), cut worms (*Noctuidæ*), and even bristly caterpillars (*Arctiidæ*); but as far as this investigation goes they have not been known to take adult *Lepidoptera*, although Bachman says he has seen them seize butterflies and moths on the wing. To complete the items of the invertebrate food there should be added crane flies, ants, dragon flies, May flies, thousand-legs, snails, and cray fish. These, though occasionally eaten, never form any significant percentage of the food.

To this account of the loggerhead shrike are added the following field notes kindly written for this paper by Mr. E. A. Schwarz, of the U. S. Department of Agriculture:

Insects impaled by Lanius ludovicianus excubitorides in southwestern Texas.

From April 24, 1896, the date of my arrival at San Diego, Duval County, Tex., up to May 21, I do not remember having seen any impaled insects. During this time the weather was extremely dry, but quite a number of large-sized insects abounded. On May 21 a copious rainfall occurred and brought out myriads of specimens of the Scarabæid genus *Canthon* (tumble bugs). These seem to be greatly relished by the shrikes, and large numbers of specimens could now be seen impaled every day. Other species of impaled insects observed at the time were *Pasimachus*, *Dicælus*, and a single Hymenopter (*Glis*). No impaled grasshoppers were seen at this season.

The shrubs more especially selected by the birds are *Celtis pallida* and *Prosopis juliflora*, dead shrubs being preferred to living ones.

However, the number of impaled insects in early summer is small in comparison with that seen toward the end of October. Impaled grasshoppers abound now, but there is no lack of other terrestrial insects, especially Carabidæ. Some soft-bodied insects are also among them, notably various terrestrial spiders and larvæ of Carabidous Coleoptera. Finally, there are numerous lizards and horned toads. It was also then noticed for the first time that the barbs of wire fences are used for impaling insects.

Most of the impaled specimens are never eaten by the birds, and remain for many weeks on the thorns. It would seem that the bird has acquired the habit of impaling insects without having the intention of eating them.

FOOD OF NESTLING LOGGERHEAD SHRIKES.

A female parent and 6 half-grown young were collected for the purpose of ascertaining whether, as is commonly believed, young shrikes are fed upon song birds. Three-fourths of the contents of each of these stomachs were insects, mainly grasshoppers. Parts of a meadow mouse had been fed to 2 of the nestlings. Mr. F. H. King, who has made extended studies on the food of birds, cites an instance of a shrike of this species carrying a warbler to its young, but Mr. Ernest Seton Thompson, who has recently examined the stomachs of 4 fledglings, found no birds, but many beetles, grasshoppers, and bristly caterpillars. The caterpillars belonged to the family *Arctiidæ*, and were covered with spines. It is very important that the few birds which will eat such caterpillars should be rigorously protected.

SUMMARY.

The food of the butcherbird and loggerhead, as shown by 155 stomachs collected during every month in the year, and in an area extending from California to the Atlantic coast, and from Saskatchewan to Florida, consists of invertebrates (mainly grasshoppers), birds, and mice. During the colder half of the year the butcherbird eats birds and mice to the extent of 60 percent and ekes out the rest of its food with insects. In the loggerhead's food birds and mice amount to only 24 percent. It will readily be seen from the table on page 26 that the loggerhead's beneficial qualities outweigh 4 to 1 its injurious ones. Instead of being persecuted it should receive protection.

LIST OF INVERTEBRATES DESTROYED BY THE BUTCHERBIRD.

Orthoptera:
- Grasshoppers (*Acridiidæ*) { *Melanoplus.* / *Tettix.*
- Crickets (*Gryllidæ*).

Coleoptera:
- Ground beetles (*Carabidæ*).
- Tiger beetles (*Cicindelidæ*).
- Darkling beetles (*Tenebrionidæ*).

Diptera:
- Flies.

Hymenoptera:
- Ants (*Formicidæ*).
- Wasps.

Lepidoptera:
- Cut worms (*Noctuidæ*).
- Bristly caterpillars (*Arctiidæ*).

Arachnida:
- Spiders.

Myriapoda:
- Thousand-legs (*Julus*).

Crustacea:
- Sand fleas (*Amphipoda*).

LIST OF INSECTS DESTROYED BY THE LOGGERHEAD.[1]

Orthoptera:

- Grasshoppers
  - *Acrididæ*
    - *Melanoplus femurrubrum.*
    - *Camnula atrox.*
    - *Dissosteira carolina.*
    - *Schistocerca americana.*
  - *Locustidæ.*
- Crickets and mole crickets (*Gryllidæ*).

Coleoptera:

- Ground beetles (*Carabidæ*)
  - *Anisodactylus.*
  - *Amara interstitialis.*
  - *Lebia.*
  - *Harpalus.*
  - *Pterostichus.*
  - *Carabus ?.*
- Scarabæids
  - May beetles.
  - Tumblebugs
    - *Canthon.*
    - *Geotrupes.*
  - Dung beetles (*Aphodius hyperborcus*).
  - Flower beetles (*Euphoria*).
- Histerids (*Hister*).
- Longicorn beetles (*Cerambycidæ*).
- Rove beetles (*Staphylinidæ*).
- Tiger beetles (*Cicindelidæ*).
- Click beetles (*Elateridæ*) [*Melanotus*].
- Carrion beetles (*Silphidæ*)
  - *Silpha ramosa.*
  - *Necrophorus marginatus.*
- Weevils (*Rhynchophora*).
- Darkling beetles (*Tenebrionidæ*)
  - *Upis ceramboides.*
  - *Eleodes tricostata.*

Hemiptera:

- Bugs (*Heteroptera*).

Odonata:

- Dragon flies
  - *Agrion.*
  - *Libellula.*

Lepidoptera:

- Cutworms (*Noctuidæ*).
- Canker-worms (*Geometridæ*).
- *Arctiidæ.*

Hymenoptera:

- Ants
  - *Formicidæ* — *Camponotus pennsylvanicus.*
  - *Myrmicidæ.*
- Wasps (*Vespina, Sphecina, Urocerus*).

Diptera:

- Crane flies (*Tipulidæ*).

Ephemeridæ:

- May flies.

OTHER INVERTEBRATES DESTROYED BY THE LOGGERHEAD.

Spiders.
Snails.
Thousand legs.

[1] Some of these insects are from records sent in by Mr. Ernest Seton Thompson.

Table showing percentages of principal elements of food of the butcherbird and loggerhead, calculated by volume.

Name.	Vertebrates.	Invertebrates.	Mammals.	Birds.	Other vertebrates.	Grasshoppers and crickets.	Spiders.	Wasps.	Caterpillars and moths.	Ground beetles.	Other beetles.	Month.	No. of stomachs.
Butcherbird	77	23	22	55	....	8	3	1	6	4	1	Dec., Jan., and Feb.	33
Loggerhead	76	24	55	14	7	13	1	....	2	4	6	Dec., Jan., and Feb.	14
Butcherbird	77	23	46	31	....	9	1	3	5	3	2	Mar. and Apr.	17
Loggerhead	20	80	9	9	2	24	9	4	11	14	18	Mar. and Apr.	16
Do	11	89	3	....	8	71	3	....	4	7	4	May and June	17
Do	2	98	....	....	2	67	2	4	1	5	19	July, Aug., and Sept.	22
Butcherbird	27	73	11	16	....	57	4	....	6	4	2	Oct. and Nov.	17
Loggerhead	10	90	....	10	....	50	5	7	3	13	12	Oct. and Nov.	19
Butcherbird	60	40	26	34	....	24	3	2	6	4	1	Average Oct. to Apr., incl.	67
Loggerhead	28	72	16	8	4	39	4	3	4	9	13	Average for the whole year.	88

THE MEADOW LARK AND BALTIMORE ORIOLE.

BY

F. E. L. BEAL,

Assistant Ornithologist, U. S. Department of Agriculture.

[REPRINTED FROM THE YEARBOOK OF THE DEPARTMENT OF AGRICULTURE FOR 1895.]

[Reprinted from the Yearbook of the U. S. Department of Agriculture for 1895.]

THE MEADOW LARK AND BALTIMORE ORIOLE.

By F. E. L. Beal,
Assistant Ornithologist, U. S. Department of Agriculture.

The oriole family includes the true orioles, the blackbirds, and the meadow larks. The different members of the tribe differ greatly among themselves in form, plumage, and habits. While the true orioles are strictly arboreal, hanging their nests among the most inaccessible twigs of tall trees, the meadow larks are mainly terrestrial, placing their humble domiciles on the ground or even sunken a little below the surface. Between these extremes come the blackbirds, some of which, as the redwing, breed among reeds and in low bushes, while others, as the crow blackbird, nest chiefly in the tops of trees. As might be expected, the feeding habits of these birds differ greatly. The oriole seeks its food almost exclusively in trees, while the meadow lark is a ground feeder. Consequently, the kinds of insects eaten are not the same. The oriole feeds largely on caterpillars and wasps, which live among leaves and flowers; the meadow lark, on the other hand, eats grasshoppers and other ground insects. After a careful consideration of their food, one can hardly fail to be impressed with the fact that both of these birds must be eminently useful to the farmer.

In the case of the meadow lark, insects constitute a large percentage of the food, and even in the winter months, when the ground is covered with snow, they form a very important element. The great bulk of these are grasshoppers, insects whose ravages have been notorious from earliest times and whose devastations in the Mississippi Valley are still fresh in the minds of the farmers of that region. The number eaten is so enormous as to entitle the meadow lark to rank among the most efficient of our native birds as a grasshopper destroyer. Nor are the other components of its insect food less important except in quantity. Some of the most injurious beetles form a considerable percentage of the stomach contents, while the useful species do not appear so often as might be expected from the terrestrial habits of the bird. The other insects eaten—ants, bugs, caterpillars, and beetle larvæ—are almost all destructive, and their consumption by birds is a decided benefit to man.

The oriole, although differing radically from the meadow lark in food and manner of life, is not the less beneficial from an economic point of view. It is a most potent factor in the destruction

of caterpillars, eating so many that if no other insects were taken it would still be classed as a useful bird. It does not, however, restrict its diet to caterpillars, but eats great numbers of injurious beetles, and also many bugs and grasshoppers. In the matter of vegetable food the record is nearly as good, for although corn, peas, and a few fruits are eaten, they appear in such small quantities as to have little economic significance.

FOOD OF THE MEADOW LARK.

The common meadow lark is a familar bird of the open country throughout the United States, although it is less abundant in the desert areas. Alike on the meadows of the East, the prairies of the West, and the savannas of the South, its clear pipe may be heard in the spring, announcing the return of the season of mating and nest building. It chooses for its home meadow lands or other level ground free from trees, and, if possible, near a supply of water, for it delights to drink and bathe in clear running brooks. Its nest, usually overarched to protect the eggs and the sitting bird from the weather, is built on the ground among last year's herbage, and is often so completely hidden as to defy the efforts of the most skillful searcher. The bird's preference for unmown fields, covered with what farmers call "old fog," has given rise to the name "old-field lark," by which it is known in some places.

While the great bulk of the species migrate from the Northern States, small flocks sometimes remain throughout the winter. South of the latitude of Pennsylvania the birds may be found at all seasons, though in somewhat reduced numbers during the colder months. Early in March they begin to move northward, and soon spread over the whole northern United States and extend into Canada. The southward migration begins in September, and by the end of October all are gone.

The common meadow lark (*Sturnella magna*) inhabits the eastern United States and ranges as far west as the Great Plains. The Western form (*S. neglecta*) is mingled with it in the Mississippi Valley, and thence to the Pacific Coast replaces it completely. The economic aspects of the two birds are practically the same.

As a rule farmers do not look upon the meadow lark (fig. 110) as an injurious bird, though a few complaints against it have been received. It has been accused of pulling sprouting grain and of eating clover seed (presumably newly sown) to an injurious extent. As these are the only charges of any consequence among thousands relating to damage done by other birds, it appears that the food habits of the meadow lark do not materially conflict with the interests of the farmer. This supposition is fully substantiated by the result of examinations of the contents of the bird's stomach, and it is still further shown that, far from being injurious, it is one of the most useful allies to agriculture, standing almost without a peer as a destroyer of noxious insects.

In the laboratory investigation of the food of the meadow lark, 238 stomachs were examined; these were collected in 24 States, the District of Columbia, and Canada, and represent every month in the year. A summary of the stomach contents for the whole year is as follows: Insect food, 71.7 per cent; vegetable food, 26.5; mineral matter, 1.8. Excluding the mineral element, which is not food, the record stands: Animal matter, 73 per cent; vegetable, 27. In other words, nearly three-fourths of the meadow lark's food for the year, including the winter months, consists of insects.

In August and September the meadow lark subsists almost exclusively on insect food, but this is not surprising, as insects are abundant at this season. In March, however, insects are not readily found; yet the meadow lark finds enough to make 73 per cent of its entire food. Similarly in December and January the insect food amounts to 39 and 24 per cent, respectively.

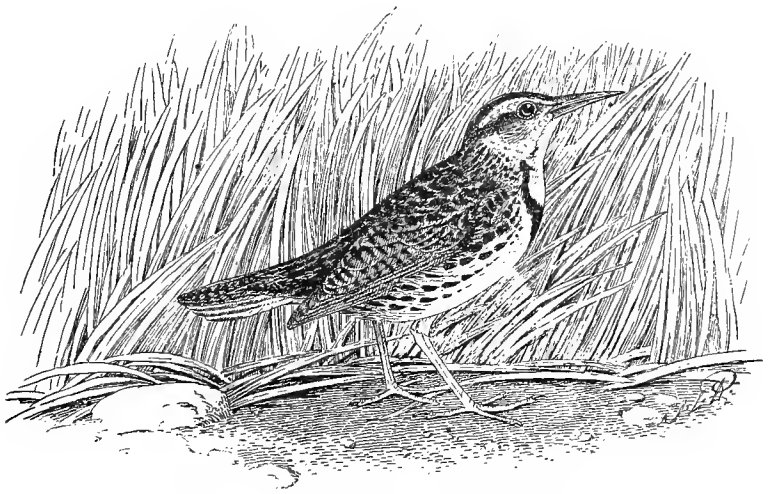


FIG. 110.—Meadow lark (*Sturnella magna*).

As an illustration of the meadow lark's vigilance in searching for insects, an instructive lesson may be drawn from the examination of the stomachs of 6 birds killed in Virginia when the ground was covered with snow. The smallest quantity of insect food in any one of the 6 stomachs was 8 per cent of the contents, the largest quantity 95 per cent, and the average for all 6 more than 47 per cent, or nearly half of the total food. The insects consisted of beetles of several species, bugs (*Hemiptera*), grasshoppers, crickets, a few wasps, caterpillars, spiders, and myriapods. Thus it is evident that insects form an essential element of the bird's diet, and are obtained even under very adverse circumstances.

Of the total insect food of the 238 birds examined, grasshoppers, locusts (green grasshoppers), and crickets constitute by far the most

important element, averaging 29 per cent of all food consumed during the year. Even in January they form more than 1 per cent, and increase rapidly until August, when they reach the surprising amount of 69 per cent. They decrease slowly during the autumn months, but in November still amount to 28 per cent, but naturally fall away quickly in winter. It is extremely doubtful if any other bird will show a better grasshopper record than this. Professor Aughey, in his report on the insects eaten by the birds of Nebraska (First Annual Report U. S. Entomological Commission, 1877, Appendix II, p. 34), credits the meadow lark with destroying large numbers of grasshoppers. It should be borne in mind that the birds which form the subject of this paper were not collected in any region especially infested with grasshoppers, but were gathered from nearly all parts of the United States. Out of the whole number of stomachs (238), 178 contained grasshoppers, one containing as many as 37. Of the 28 birds taken in August, in seven different States, all but one contained them, and one stomach, from New York, was filled with 30 common grasshoppers, 14 green grasshoppers (*Locustidæ*), and 10 crickets. Of 29 stomachs collected in seven States in September, every one contained grasshoppers, and two contained nothing else. Of the 40 stomachs collected in October from ten States, all but two contained grasshoppers and crickets.

Dr. A. K. Fisher has made some interesting calculations upon the amount of hay saved by the destruction of grasshoppers by Swainson's hawk, and it would not seem to be out of place to attempt to reduce to a numerical basis the good done by the meadow lark in the consumption of these insects. Dr. Fisher gives the weight of an average grasshopper as 15.4 grains, and entomologists place the daily food of a grasshopper as equal to the creature's own weight, an estimate probably much within the limit of truth. Remains of as many as 54 grasshoppers have been found in a single meadow lark's stomach, but this is much above the number usually eaten at one time. Such food, however, is digested rapidly and it is safe to assume that at least 50 grasshoppers are eaten each day. If the number of birds breeding in 1 square mile of meadow land is estimated at 5 pairs, and the number of young that reach maturity at only 2 for each pair, or 10 in all, there will be 20 birds on a square mile during the grasshopper season. On this basis, the birds would destroy 30,000 grasshoppers in one month. Assuming that each grasshopper, if let alone, would have lived thirty days, the thousand grasshoppers eaten by the larks each day represent a saving of 2.2 pounds of forage, or 66 pounds in all for the month. If the value of this forage is estimated at $10 per ton (which is below the average price of hay in the Eastern markets), the value of the crop saved by meadow larks on a township of 36 square miles each month during the grasshopper season would be about $356.

Beetles of many species stand next to crickets and grasshoppers in

importance, and constitute nearly 18 per cent of the annual food, but as these insects vary much in their economic relations it will be best to consider the different families separately. Among the most important are the May beetles (*Scarabæidæ*), a family which contains some of our most injurious insects as well as many harmless species. But as the great majority of the members live upon vegetable food, and may at any time turn their attention to useful plants, the whole family may be classed as potentially harmful, consequently the birds do no harm by eating them. The average consumption of May beetles amounts to about 4 per cent of the entire food of the year. The greatest numbers are eaten in May, when they form over 21 per cent of the food. Most of these are dung beetles, but some remains of the well-known Lachnosterna are found. The snout beetles, or weevils (*Rhyncophora*), form a small but very constant element, averaging about 3 per cent for the year. June shows the greatest consumption, with over 7 per cent, and, singularly enough, January stands next, with almost 5 per cent. The principal families represented are the curculios (*Curculionidæ*) and the scarred snout beetles (*Otiorhynchidæ*), both of which include some of the most harmful insects known, and no useful ones. The plum curculio (*Conotrachelus nenuphar*) is a well-known example.

Other beetles, belonging to about a dozen families, collectively form about 3 per cent of the whole food. Of these the most interesting are the leaf beetles (*Chrysomelidæ*), which are supposed to be disagreeable to birds, but whose remains were found in 19 of the 238 stomachs examined. The Colorado potato beetle is a member of this family, and while none were actually found, it seems highly probable that meadow larks might eat them if they fell in their way.

One of the important questions in regard to the diet of insectivorous birds is the extent to which they eat predaceous beetles (*Carabidæ*), for many of these beetles are beneficial. From its ground-feeding habits the meadow lark might be expected to subsist largely upon carabids, as they also live mainly upon the ground and are very abundant. The examination shows that these insects constitute something more than 7 per cent of the food during the year, but are very curiously distributed, attaining maxima of 20, 16, and 17 per cent, respectively, in March, July, and November, while the minimum records (less than 1, 2, and 4 per cent) fall in January, May, and September. This is certainly a very moderate showing when it is considered that the meadow lark feeds almost exclusively on the ground where these beetles are so abundant, and it seems to indicate that instead of seeking them the bird simply eats such as fall in its way in default of better food.

Bugs (*Hemiptera*) are pretty regularly eaten throughout the year, averaging 4 per cent of all the food. The greater number belong to the family of stink bugs (*Pentatomidæ*), some of which are familiar

to all who have eaten raspberries from the vines. Those who have by accident tasted the bugs will never forget the flavor and will wonder that any bird habitually eats such highly seasoned food. Most of these bugs are eaten in March, when they constitute 14 per cent of the food of the month. While some of them are harmful as well as disgusting, others do much good by devouring other insects, so that the destruction of the various members of this family is not an unmixed benefit. It is important to note that one stomach contained three specimens of the notorious chinch bug, an insect whose ravages in our wheat and corn fields have cost the country millions of dollars.

Caterpillars, or the larvæ of butterflies and moths, form a very considerable part of the food of the meadow lark, but the adults are rarely eaten, only three small moths having been found in the 238 stomachs. Caterpillars were present in every month except February, and even the stomachs taken in December contained 4 per cent of this food, while the average for the year is nearly 8 per cent. From the terrestrial habits of the meadow lark, it is evident that the caterpillars eaten must be species that live on or near the ground and feed on grass or other low plants. To this category belong the various species of cutworms. A number of these were identified in the stomachs, and no doubt many more were eaten, but they are so fragile and so soon reduced to fragments by the stomach's action that specific identification is always difficult and often impossible.

The larvæ or young of beetles were found in every month except February, and formed more than 3 per cent of the food of the year. They increased to 11 per cent in May, and were sufficiently numerous to be important throughout the season except in August, September, and October, when they amounted to less than 1 per cent.

Ants form a fairly constant element of the meadow lark's diet, averaging a little less than 3 per cent for the year. None were found in January, but in April they formed 4 per cent of the food. They decreased during the succeeding months, but increased suddenly to over 16 per cent in September, after which they again fell to an insignificant figure. Other Hymenoptera (wasps, etc.) average about 1½ per cent for the year, and are only important in June and July, when they amount to 6 and 4 per cent, respectively. Spiders and myriapods (thousand-legs) seem to be eaten quite freely, and aggregate nearly 5 per cent of the food. The largest number (8 per cent) are eaten in March and December, but the percentage falls off during the winter and in midsummer. Besides the insects already mentioned, several were found representing other orders. Flies (*Diptera*) were contained in a few stomachs, a dragon fly (*Odonata*) in one, an earwig (*Forficulidæ*) in one, and a common cattle tick (*Ixodes*) in one. Snails, or fragments of their shells, were found in seven stomachs, sow bugs (*Oniscus*) in two, a small crustacean in one,

and the bones of small frogs or toads (*Batrachians*) in three. These last were from stomachs taken in Florida, and do not appear to be a favorite food.

From the foregoing, it is evident that the meadow lark is preeminently an insect eater; still it has recourse when necessary to vegetable food.

As before stated, the total vegetable food for the year amounts to 27 per cent. Of this, grain (corn, wheat, and oats) aggregates 14.4 per cent, or a trifle more than half. The percentages of the different kinds of grain are: Corn, 11.1; wheat, 1.8; oats, 1.4. The largest quantity of grain was eaten in January, when the stomachs contained 53 per cent of corn, 11 per cent of wheat, and 9 per cent of oats. During the summer months the grain disappears, to appear again as the supply of insects fails. Sprouting grain was not found in any stomach. In April the total amount of grain was a little less than 15 per cent, and this may have been taken from newly sown fields. In May no wheat or oats were found, and only 1.9 per cent of corn.

Seeds of plants classed as weeds were found in every month except May, and it is probable that a greater number of stomachs in that month would have shown at least a few. Excepting the single stomach taken in February, which contained 75 per cent of barn-grass seed (*Chamæraphis*,) weed seeds attain their maximum of over 25 per cent in December. The average for the year is a little more than 11 per cent, or the same as corn. The remaining vegetable food averages less than 1 per cent. Fruit seems to be accidental, each of the varieties named having been found in only one or two stomachs, and in small quantity. The same is true of the articles enumerated in the miscellaneous list. Complaints have been made against the meadow lark on the score of eating newly sown clover seed to an injurious extent; this seed, however, was found in only six stomachs, and each contained but a few seeds.

The testimony of the stomachs does not indicate that grain is preferred to other seeds, and it can not be urged that it is less easily obtained than seeds of weeds, for grain is a prominent crop throughout much of the country inhabited by meadow larks, and on account of its larger kernels is picked up more easily than smaller seeds. The meadow larks might be expected to injure grain when they collect in flocks, as they sometimes do, but at the time of harvesting wheat and oats they are not found in flocks, and the record shows that practically no wheat or oats were found in the stomachs, it being the season when insects were most abundant and formed nearly the whole food. As an illustration, the stomach of a bird killed in a field of shocked oats contained nothing but insects. In September and October, when corn is being harvested, the amount of this grain found in the stomachs was less than 1 per cent. In November, when insects begin to fail, the vegetable food increases, but it is worthy of note that weeds (*Ambrosia*,

Chamæraphis, etc.) are preferred, for in this month grain amounts to only 6 per cent, while weed seeds reach 15 per cent.

In summing up the record of the meadow lark, two points should be especially noted: (1) The bird is most emphatically an insect eater, evidently preferring insects above all other food; and (2) in default of its favorite food it can subsist on a vegetable diet. Prof. S. A. Forbes, in discussing the food of predaceous beetles (Bull. Ill. State Lab. Nat. Hist., Vol. I, No. 3, p. 159), calls attention to the fact that species which are able to vary their diet and subsist upon vegetable food when their ordinary supply of insects fails, are much more valuable than those which are entirely carnivorous. This is exactly the case with the meadow lark. For this reason a relatively short migration enables it to bridge over periods of scarcity of its favorite food.

FOOD OF THE BALTIMORE ORIOLE.

The Baltimore oriole, golden robin, or hang-nest (fig. 111), as it is variously called, is so well and so favorably known throughout the country that it may seem almost unnecessary to show that its food habits are as beneficial as its song and plumage are pleasing. In most places where this bird makes its home, the people, especially the farmer-folk, would no more think of killing it or destroying its nest than would the Hollander shoot the stork that nests on his roof.

The Baltimore oriole (*Icterus galbula*) breeds throughout the eastern United States north of Virginia, and reaches somewhat farther south in the Mississippi Valley. It is abundant in New England, and extends west over the tree-covered parts of the Great Plains, beyond which it is replaced by another species of much the same appearance (*I. bullocki*). In New England the oriole usually comes with the flowering of the apple trees, in the latter half of May; in the West it appears somewhat earlier. As its food consists largely of insects that live in the foliage of trees, its arrival in the North is delayed until these have become plentiful. It begins to move southward early in August, and is rarely seen in September, though one of the specimens examined was taken in Connecticut as late as November 16; but this must be regarded as a belated straggler. The species passes south of the United States, to spend the winter in the warmer countries beyond.

The present preliminary report is based on the examination of the contents of 113 stomachs, collected in 12 States, the District of Columbia, and Canada, and ranging from Massachusetts, on the east, to Kansas and North Dakota, on the west. They were all collected during the months from April to August, inclusive, with the exception of a single specimen taken in November. They are distributed by months as follows: April, 2; May, 45; June, 32; July, 18; August, 15; and November, 1.

The food for the whole season consisted of 83.4 per cent of animal matter and 16.6 per cent of vegetable matter. The mineral matter

found in the stomachs is not really food, and was taken in such small quantities that it may be disregarded. As April is represented by only two stomachs, and November by one, the results for these months can not be considered as final. Excluding November, the largest amount of insect food was eaten in May, when it formed 92 per cent of the food, and the smallest in April and July, when it formed 70 per cent. The single November stomach contained 98 per cent of insects.

The most important item of the insect food is caterpillars, which aggregate more than 34 per cent of the whole. Contrary to what might have been expected, the Connecticut stomach taken in November contained 81 per cent of these insects. This accords with what has been noted by many observers in the field, that the oriole spends a

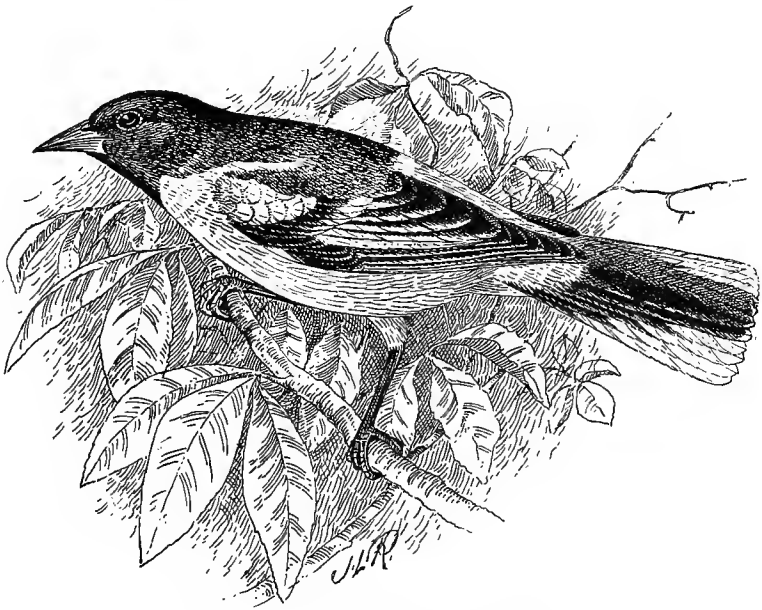


FIG. 111.—Baltimore oriole (*Icterus galbula*).

great deal of time searching among leaves and branches, where such insects abound. An average of 25 per cent of caterpillars was found in the two stomachs taken in April, and this percentage continued without much variation until July, when it dropped to 12, July being the month when most fruit was eaten. After July the percentage of caterpillars eaten increases rapidly.

Beetles of various families and species rank next to caterpillars in abundance. Those most eaten are the click, or snapping, beetles (*Elateridæ*), insects having very hard shells, which would seem to render them undersirable for food. Although eaten during May, June, and July only, click beetles constitute 9 per cent of the food for these months or 4.5 per cent for each of the six months under consideration.

These beetles and their larvæ, known as "wireworms," are among the most destructive insects with which the farmer has to contend. Professor Comstock says of the click beetles:

> There is hardly a cultivated plant that they do not infest; and working as they do, beneath the surface of the ground, it is extremely difficult to destroy them. Not only do they infest a great variety of plants, but they are very apt to attack them at the most susceptible period of their growth, before they have attained sufficient size and strength to withstand the attack, and often the seed is destroyed before it has germinated. Thus fields of corn or other grain are ruined at the outset.

As there are over 500 species of snapping beetles in North America, it is easy to understand how welcome is any assistance in the struggle against them, and it is gratifying to know that the oriole is especially fond of them.

The May beetles (*Scarabæidæ*) stand next to the click beetles in importance as food of the oriole. They were found in stomachs collected during every month from May to August, but only in May and June was the percentage important, viz, 12 and 7 per cent, respectively. The average for the whole season was 3½ per cent. These insects consisted of the common May beetle (*Lachnosterna*), several species of dung beetles (*Aphodius*), and a number of the leaf-eating beetles (*Dichelonycha*). So far as known dung beetles do no harm, but the other two genera are very injurious. Leaf beetles (*Chrysomelidæ*) are not supposed to be a favorite food of birds, owing to their disagreeable excretion, but they were eaten by the orioles in every month except November. In July they amounted to 8 per cent, in August 5, and averaged nearly 3 per cent of the food for the season. More than half a dozen species belonging to this family were identified in the contents of the stomachs. Among them was the well-known striped squash beetle (*Diabrotica vittata*), which in the larval state bores the roots of squashes or cucumbers, and when adult feeds on their leaves.

Another member of the same family (*Odontota dorsalis*) feeds on the leaves of the locust, and in some places ruins the trees, while another of the same genus (*O. rubra*) feeds on apple trees. Both of these were identified in the stomachs. Snout beetles or weevils (*Rhyncophora*) form a small but fairly constant element of the oriole's diet, amounting to a little more than 2 per cent for the season. In May they formed 5 per cent of the food, and then decreased to less than 2 per cent in July, but in August increased a little. All are noxious insects, and belong for the most part to the families of the curculios and the scarred snout beetles (*Otiorynchidæ*). Members of six other families of beetles were found, but not in sufficient numbers to be of economic importance, although it is interesting to note that one of the blister beetles was among the number. As most of these beetles contain a secretion that produces blisters, it would seem to us that they must be rather disagreeable as an article of food.

The predaceous beetles (*Carabidæ*) constitute an element of great interest in the food of any bird, since the number eaten is commonly taken as a criterion of the comparative usefulness of the bird. As these beetles themselves live for the most part on other insects, it is evidently desirable that they should be allowed to pursue this good work as long as possible. That they are not molested by orioles is proved by the fact that in the stomachs examined predaceous beetles averaged only one-half of 1 per cent for the season, and the greatest number taken in any month amounted to little more than 1 per cent.

Wasps (*Hymenoptera*) constitute an important element of the food in every month, varying from 20 per cent in April to about 8 per cent in July, and averaging nearly 11 per cent for the season. As these insects spend a large part of their time buzzing about flowers and leaves, it seems only natural that they should be eaten by the oriole. Ants, which also belong to the *Hymenoptera*, are eaten to some extent through the spring and summer, but are only important in April and May, when they form about 10 per cent of the food. They belong for the most part to the large black species of *Camponotus*, which live on trees and nurse plant lice.

Bugs (*Hemiptera*) of various species are favorites with the orioles, as they are with many other birds, and form about 6 per cent of the food for the season. None were found in April, about 4 per cent in May, after which they increased to nearly 10 per cent in July, but again decreased to 4 per cent in August. Many of these are stink bugs (*Pentatomidæ*), which crawl over berries and impart a disgusting flavor to them. Others belong to the family of assassin bugs (*Reduviidæ*), which feed on other insects; but the most interesting members of this order are the scale lice (*Coccidæ*) and common plant lice (*Aphides*), two of the most destructive families of insects known. They are so minute that it seems surprising that any bird should care to eat them, but scale lice were found in eight stomachs and aphids in four. Flies (*Diptera*) make up more than 4 per cent of the food in May, and no less than 7 per cent in the single stomach taken in November. The most interesting are the larvæ of the March fly (*Bibio*), of which one stomach contained about 100. These larvæ feed on roots of grass and evidently must have been obtained from the ground. Several long-legged crane flies (*Tipulidæ*), with their eggs, were also found.

Grasshoppers and locusts were eaten in June, July, and August to the extent of 1, 11, and 17 per cent, respectively. In capturing these insects it is evident that the orioles must alight on the ground, attracted no doubt by the abundant supply and the ease with which such food can be obtained, for at this season it can hardly be supposed there is a dearth of caterpillars and other insects which they usually find on the trees. Spiders also constitute a favorite food, averaging nearly 6 per cent for the season. In May they form 5 per cent

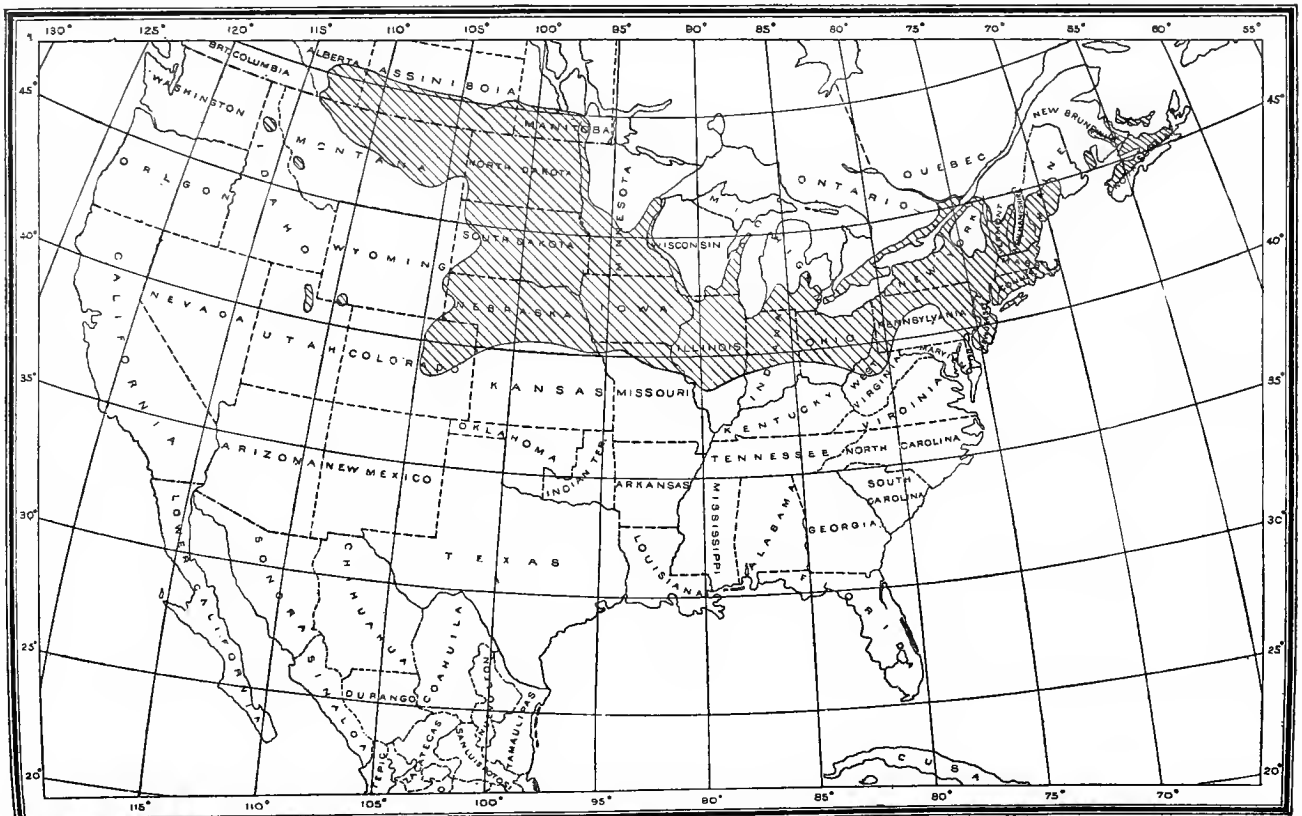
of the food, and gradually increase to nearly 12 per cent in August. Some of the stomachs taken during the breeding season in April, May, and June contained bits of snail shells, which were probably eaten for the lime they contain.

Vegetable food of the oriole.—For its vegetable food, the oriole prefers fruit, but also eats grain and the seeds of weeds. Six kinds of fruits were found in the stomachs. Of these, cherries, raspberries, and mulberries are or may be cultivated. Cherries were identified in two stomachs, and four others contained fruit pulp too much digested for recognition. Assuming that this pulp came from cherries, six stomachs in all contained this fruit. Raspberries or blackberries were found in eleven stomachs. As this fruit is as likely to be wild as cultivated, the record does not necessarily indicate that the bird does much damage. Mulberries were found in only three stomachs, Juneberries in nine, huckleberries in one, and elder berries in one. Next to Rubus fruits (blackberries and raspberries), Juneberries seem to be preferred, and it is noteworthy that several orioles shot on or near cherry trees in bearing had no cherries in their stomachs, but some seeds of Rubus and Juneberries.

Green corn was found in one stomach and peas in two, hardly enough to establish the bird's reputation as a pilferer of fields and gardens; and as only one observer has seen it eat peas, and none corn, it may be safely said that the harm done is trifling. No traces of sprouting oats or other grain were discovered, except in one stomach, taken in April, which contained some obscure vegetable substance that may have been sprouting peas nearly digested.

If the two stomachs taken in April and the one in November are excluded, the percentage of vegetable food for the season stands about as follows: May, 7 per cent; June, 8; July, 29; August, 12. The sudden rise in July and the falling off in August are very noticeable. Moreover, in July the vegetable food consisted entirely of fruit.

While the generally harmless character of the oriole is almost universally acknowledged, a few instances of damage to fruit have been reported. It is accused of eating berries and garden peas, and several correspondents say that it injures grapes. Even John Burroughs brands it as an enemy of the vineyard, but the harm it does in this way is probably overestimated. Mr. W. F. Webster, of Oshkosh, Wis., states that it sometimes punctures grapes to suck the juice, but adds that the bird is worth its weight in gold as an insect destroyer. The stomach examinations show that it destroys immense numbers of caterpillars, grasshoppers, bugs, and noxious beetles, and does not prey to a noticeable extent on predaceous or useful beetles. Added to these good qualities, its brilliant plumage, sprightly manners, pleasing song, and skill in nest building excite our admiration. Let the farmer continue to hold his good opinion of the oriole, and accord it the protection it so well deserves.



MAP SHOWING BREEDING RANGE OF THE BOBOLINK (*Dolichonyx oryzivorus*).

BULLETIN No. 13

U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF BIOLOGICAL SURVEY

FOOD

OF THE

BOBOLINK, BLACKBIRDS, AND GRACKLES

BY

F. E. L. BEAL, B. S.

ASSISTANT BIOLOGIST

PREPARED UNDER THE DIRECTION OF

DR. C. HART MERRIAM

CHIEF OF BIOLOGICAL SURVEY

WASHINGTON

GOVERNMENT PRINTING OFFICE

1900

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Biological Survey,
Washington, D. C., May 22, 1900.

Sir: I have the honor to transmit herewith for publication as Bulletin No. 13 a report on 'The Food of the Bobolink, Blackbirds, and Grackles,' by Prof. F. E. L. Beal, assistant biologist. This report is based on a careful examination of the contents of more than 4,800 stomachs, representing nine species and several subspecies of American blackbirds. The family of orioles and blackbirds, to which the bobolink, cowbird, blackbirds, and grackles belong, is one of much economic importance. The ravages of the bobolink in the rice fields of the South, and of some of the blackbirds in the grainfields of the Upper Mississippi Valley at planting and harvesting time, are matters of common knowledge, but the other food of these and other species is not so well known. The present bulletin is devoted mainly to the food of the various blackbirds during the summer months; several of the species consume insects in such quantities at this time as to compensate in great measure for the grain they destroy.

Respectfully,

C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

FOOD OF THE BOBOLINK, BLACKBIRDS, AND GRACKLES.

By F. E. L. Beal, B. S.,

Assistant Biologist, U. S. Department of Agriculture.

INTRODUCTION.

The birds commonly known as bobolinks, meadowlarks, orioles, blackbirds, grackles, and cowbirds are all comprised in a group known as the family Icteridæ, which is represented in the United States by 29 species and subspecies. These differ remarkably in plumage, nesting habits, and methods of obtaining food. The plain black in which many of them are clothed is relieved in the redwing by a touch of brilliant color, and in the bobolink (in spring dress) by white and buff; in the orioles it is usually reduced to a few patches to offset the bright tints; and in the meadowlarks is restricted to a black crescent on the breast. The orioles build their nests in trees, sometimes at a considerable height, and obtain their food among the leaves and branches. The bobolinks and meadowlarks build upon the ground and depend for food upon such insects and seeds as they find on the surface. The other species take an intermediate position, some, such as the crow blackbird, building in trees, and others on low bushes and rushes, but all obtaining the greater part of their food on the ground.

In this bulletin are discussed the food habits of the bobolink, the cowbird, the yellow-headed blackbird, the red-winged blackbird, the California red-winged blackbird, the rusty blackbird, Brewer's blackbird, the crow blackbird, and the boat-tailed grackle. These comprise all the important members of the group with the exception of the meadowlarks and orioles.[1] One or more of these species may be found at some time of the year in every State and Territory. As they are much given to nesting and feeding about farms and stock yards or to visiting outlying grainfields and pastures, the character of their food becomes a question of considerable importance to the cultivator.

[1] A report on the food of the meadowlark and Baltimore oriole was published in the Yearbook of the Department of Agriculture for 1895, pp. 419–430; a preliminary report on the food habits of the crow blackbird appeared in the Yearbook for 1894, pp. 233–248; and the grain-eating habits of most of the blackbirds were discussed under the title 'Birds injurious to grain,' in the Yearbook for 1897, pp. 345–354.

Writers on ornithology give notes on the food of various species of birds, based for the most part on field observation, and in some cases on examination of stomachs, but usually such investigations are neither extensive nor systematic. In the early days, when birds were abundant and grainfields few, blackbirds, or 'maize thieves,' as they were called, were the first species to render themselves objects of notice by their attacks upon the crops of the early settlers, and bounties were offered for their destruction; in fact, they had already acquired a bad reputation with the aborigines by their depredations upon the patches of maize. Their very pronounced taste for grain, and their habit of associating in large flocks, soon attracted the attention of pioneer farmers everywhere; and it did not take these shrewd observers long to decide that the birds were a nuisance and to plan for their extermination. All devices of this kind, however, have (fortunately, perhaps) proved futile. The birds still flourish, though in somewhat reduced numbers, and are still a source of considerable damage in many places.

At the present day direct bounties are not so much in vogue as they were when the country was newer; and State laws protecting birds have become numerous. But the evil repute of the blackbirds has caused them to be omitted from many of these statutes, while in others either blackbirds in general or particular species are specially exempted from protection. Blackbirds in general are specially exempted in Maryland, Michigan, Wisconsin, Minnesota, and Arkansas; the crow blackbird in Vermont, Massachusetts, South Carolina, and Illinois; the ricebird (bobolink) in Georgia; the 'common blackbird' and the crow blackbird in New York; the crow blackbird in Rhode Island; and the crow blackbird and redwing in New Jersey.

In certain States near the Atlantic seaboard some species, notably the bobolink, are regarded as game, and an open season is provided for shooting them. In New Jersey 'reedbirds' (bobolinks) may be lawfully killed from August 25 to January 1; in Pennsylvania from September 1 to November 30; in Delaware from September 1 to February 1; and in Maryland between September 1 and November 1. In the District of Columbia the redwing is included with the bobolink, and shooting is permitted on Tuesdays, Thursdays, and Saturdays, between August 21 and February 1.

The investigation of the food of blackbirds by the examination of the contents of their stomachs, while confirming to a certain extent the popular estimate of their grain-eating propensities, has shown also that during the season when grain is not accessible these birds destroy immense quantities of seeds of harmful weeds, and that during the whole of the warmer portion of the year, even when grain is easily obtained, they devour a great number of noxious insects. The vegetable portion of the food usually considerably exceeds the animal.

The latter consists mostly of insects,[1] with the addition in a few species of some crustaceans and snails and now and then a small vertebrate. The vegetable food comprises chiefly hard seeds, of which any grain may be taken as a sample. Fruit is eaten by a few species, but not to an injurious extent, and various other vegetable substances are occasionally taken, such as bits of fleshy tubers or roots, mast, mushrooms, etc.

If the blackbirds were to be rated in the order of their grain-eating propensities as shown by stomach examinations, putting those that eat least at the head of the list, they would stand about as follows: Bobolink, redwing, cowbird, rusty blackbird, yellowhead, crow blackbird, boat-tailed grackle, Brewer's blackbird, and California redwing. It is a singular fact that the first two are the ones against which the greatest complaint has been made, thus showing that some factors beside the amount of grain actually eaten by the individual must be taken into account in determining the relative harmfulness of the species. In the case of the bobolink, however, it should be explained that the stomachs upon which the record is founded were nearly all taken in the North, and do not exhibit the bird's rice-eating propensities. Still it is probable that if a proportionate number of stomachs from Southern States were included in the examination there would be no great change in the result. The damage from which the complaint arises is due to the fact that all the bobolinks reared in the Eastern States gather in spring and autumn upon a limited area and attack a single crop—rice. But owing to the comparative shortness of the rice-eating period the amount consumed by each bird must constitute but a small percentage of the food of the year.

The redwing probably owes its bad reputation as a grain eater to its superabundance in the great grain-raising regions of the West. Number of individuals, rather than amount of grain consumed by each, is here probably the important factor. The cowbird, well known as a frequenter of roads and barnyards, is not notorious as a grain eater, and it is probable that the greater part of the 16 percent of grain found in its stomach is waste. The rusty blackbird has not been accused of much damage, and in fact is not in this country at harvest time, so that the greater part of the grain it eats is also probably waste. The yellowhead has gained an unenviable reputation in some parts of the West, and in point of harmfulness is reckoned by the farmers with the redwings, with which it associates. This is not surprising, as nearly 40 per cent of its food is grain; if it were as abundant as the redwing, it would probably be a much greater nuisance than that species. The crow blackbird, while eating a consider-

[1] For convenience, spiders and myriapods (thousand-legs) are classed as insects in this investigation.

able quantity of grain, has not been the cause of so much complaint as the foregoing species, perhaps because of its well-known habit of nesting about farmsteads, where it obtains a large portion of its food from the barnyards and grain cribs. The boat-tailed grackle is so local in its distribution that its food habits are familiar to comparatively few. It confines its grain eating almost exclusively to corn, which it appears to eat at every opportunity. Unlike most of the other species, it also damages fruit. The western Brewer's blackbird, with grain constituting more than 60 percent of its food, would naturally be supposed to be a dangerous neighbor for the grain grower, and where it has come in contact with the grainfield it has fulfilled this expectation. The California redwing is confined to a comparatively small part of the country, and its food habits have not yet received much attention. It seems almost certain that it must become a nuisance, but the record of its food is too meager to justify final conclusions.

The animal food of these nine species of blackbirds must be counted for the most part in their favor, as the insects eaten are generally noxious. Only one species (the crow blackbird) shows any special fondness for the valuable predaceous beetles (Carabidæ), and these amount to less than 6 percent of its food. The snout-beetles (Rhynchophora), commonly known as weevils, seem to be specially sought during the early summer. In the five months from April to August, inclusive, 9 percent of the food of the bobolink consists of these harmful beetles, a record which is slightly exceeded by the redwing for the same time. In May they constitute more than one-fourth of the food of Brewer's blackbird. As all the members of this group of beetles are noxious, and as two species that have been identified in great numbers in the birds' stomachs are very harmful to forage crops, the benefit derived from this destruction is obvious. In the consumption of grasshoppers, Brewer's blackbird heads the list, more than 16 percent of its food consisting of these pests; while the redwing (excluding the California bird) stands at the foot, with a little less than 6 percent. In August, Brewer's blackbird takes more than 47 percent of its food in grasshoppers, and the rusty blackbird and cowbird only a little less. Being mainly terrestrial, the blackbirds do not naturally come in contact with caterpillars so frequently as they would if they sought their food upon trees or shrubs; but nevertheless these insects constitute 13 percent of the food of the bobolink, nearly 6 percent of that of the redwing, and but little less of that of several others. The other insects eaten are, with an occasional exception, harmful, and though distributed among several different orders, form a noticeable percentage of the food. The crustaceans and snails may be considered neutral.

In regard to the economic status of the blackbirds, it may be said that the damage done by the redwings and some other species has apparently arisen from the excessive number of individuals rather than from the habits of the species. Thoughtful students of nature have observed that every race or species has a certain high-water mark of abundance, beyond which it can not rise without danger of encroaching upon and injuring other species. This is true of every species, whether at its normal abundance it be beneficial to man or otherwise. The exemplification of this principle is most noticeable in the case of insects, many species of which frequently exceed their ordinary bounds and spread destruction among crops. But the rule is equally applicable to birds; however useful they may be in a general way, it is possible under certain conditions that particular species may become too numerous.

There is no reasonable doubt that in the Mississippi Valley the redwings and yellowheads, and farther west Brewer's blackbird, are much too abundant for the interests of the grain grower. The facilities for nesting afforded by the prairie sloughs and marshes, where for ages these species have been undisturbed, have given rise to such immense hordes that they can in a few hours destroy hundreds of acres of grain, or at least take so much that the remainder is not worth harvesting. Originally the birds obtained their food from wild plants, but with the advent of civilized man and the planting of grain-fields a new source of food was provided. The wild rice (*Zizania aquatica*), which was one of their favorite foods, does not ripen till September, but wheat and oats are ripe from June to August, and are much more abundant and more easily obtained than any of the wild seeds. What wonder that the birds at once availed themselves of this new supply of food spread before them with such a lavish hand! In the early days of settlement the fight near large marshes to save the grain from redwinged blackbirds was as fierce as is now the struggle in the South to save the rice crop from the bobolinks. As the country has become more thickly settled a greater area of grain is sown and the damage is relatively less and more widely distributed. With the further advance of civilization, and the broadening of the area of cultivation, many of the marshes will be drained and the present nesting places will become arable fields. This will necessarily reduce the numbers of the birds, and it is almost certain that in time they will reach the limit at which they are no longer harmful, as is already the case in the Eastern States.

Perhaps the most peculiar case presented by any of our birds is that of the bobolink. Loved and cherished in the North, and there made the subject of poetry and romance, in the South it is execrated and destroyed and conceded but one redeeming quality—that its body is

good to eat. In the North it does much good and practically no harm; in the South it becomes a veritable pest. To a person born and reared in New England and taught to regard this bird somewhat as the Hollanders regard the stork, it is an unwelcome duty to pronounce upon it a verdict of condemnation, but the facts force the belief that until some practical method shall be devised to prevent its ravages upon the rice crop there can be no other conclusion than that the good done by the bobolink does not in any appreciable measure counterbalance the harm.

THE BOBOLINK.

(*Dolichonyx oryzivorus.*)

Within the memory of many persons who have passed the half-century mark most of the literature of the bird world available to Americans was that imported from Europe, and stories of the skylark

FIG. 1.—Bobolink.

and of the little robin-redbreast were the amusement of their simple childhood. They often wondered why they never saw these birds. But when American writers fully awoke to the beauty and attractiveness of their native birds, tales, both in verse and prose, of birds to be seen every day in our own fields and forests began to find their way into the household. Among these familiar little friends one of the first to be enshrined in song and story was the bobolink.

The peculiar difference in the plumage of the two sexes and the idiosyncrasies of the song of the male have long rendered the bobolink a marked bird in its summer home in the Northern States. Few species show such striking contrasts in the color of the sexes, and few have songs more unique and whimsical. Even the early settlers recognized the grotesqueness of some of its notes in their imitative name of 'conquiddle.' In the South it is universally known as the 'ricebird,' from its habit of preying upon rice, while in the Middle States during its southward migration it is called 'reedbird.'

The breeding range of the bobolink is confined to the Transition and Carolinian zones. It occupies the northern part of the United States and the southern part of the British Provinces, extending from the Atlantic to the Rocky Mountains, and locally beyond to eastern Idaho and eastern Nevada (see frontispiece). In winter the bird retires beyond our southern border, ranging southward as far as Brazil. In the last half of April it enters the United States just as the rice is sprouting in Southern rice fields, and at once begins to pull up and feed upon the sprouted kernels. Its stay is short, for this is the season of reproduction, and it hastens northward to enter upon that function.

The nesting usually takes place in a meadow or mowing field, not far from a running brook or spring, and the young are generally upon the wing in the latter part of July. Up to this time they have been fed upon insects, but now the whole family, clad in plain clothes (for the male has lost his bright spring garb), betake themselves to swamps for wild rice, to weed patches for seed, or sometimes to grainfields for oats; but all the time they move slowly toward the South. The small flocks unite; all those that breed in the northeastern part of the country concentrate along the marshes and inlets of the seashore, and the whole body, constantly growing by accessions from other parts of the range, moves steadily southward toward the rice fields—an army vaster than that of Xerxes. The birds begin to arrive upon the rice fields about August 20, and from that time until the last of them wing their way to their winter home, nearly two months later, there is no rest for the unfortunate rice grower. They swarm upon the fields by millions, and when frightened off at one place at once settle upon another a short distance away.

In some of the previous publications on the bobolink the havoc the bird causes among the rice fields of the South does not appear. Audubon mentions its injury to cornfields in Virginia, Maryland, and Pennsylvania, and states that its food consists of grubs, caterpillars, beetles, grasshoppers, crickets, and ground spiders, and the seeds of wild oats (*Zizania aquatica?*), wheat, barley, rice, and other grasses.[1]

[1] Ornith. Biog., Vol. I, pp. 284–286, 1831.

C. J. Maynard speaks of its feeding in Pennsylvania on a somewhat peculiar grass which springs up after the wheat is harvested and affords abundant food for them during the latter part of October.[1]

Dr. Warren also confines himself to its feeding habits in Pennsylvania. He says:

> The food of these birds during their spring sojourn in Pennsylvania is composed chiefly of different kinds of terrestrial insects, also the seeds of various weeds, grasses, etc. I have examined the stomach contents of twenty-seven Bobolinks * * * and found that eighteen had fed exclusively on beetles, larvæ, ants and a few earthworms; five, in addition to insects and larvæ, showed small seeds, and particles of green vegetable materials, apparently leaves of plants; the four remaining birds revealed only small black and yellow colored seeds. After the breeding season the Reedbirds * * * about the middle of August, again make their appearance in our meadows and grainfields. At this time, although various forms of insects are abundant, they subsist almost entirely on a vegetable diet. They visit the cornfields and * * * prey to a more or less extent on the corn; * * * they tear open the tops of the husk and eat the milky grain. Fields of Hungarian grass are resorted to and the seed eagerly devoured. The different seeds of weeds and grasses which grow so luxuriantly in the marshy swamps and meadows are likewise fed upon with avidity.[2]

In these statements the bird's destructiveness in the South is not considered; but it has been well understood for a long time. Mark Catesby, whose work on the natural history of Carolina contains the first published general account of the birds of this country, says:

> In the beginning of September, while the Grain of Rice is yet soft and milky, innumerable Flights of these Birds arrive from some remote Parts, to the great detriment of the inhabitants. *Anno* 1724, an Inhabitant near Ashley river had forty acres of Rice so devoured by them, that he was in doubt, whether what they had left, was worth the expense of gathering in.
>
> They are esteemed in Carolina the greatest delicacy of all other Birds. When they first arrive, they are lean, but in a few days become so excessive fat, that they fly sluggishly and with difficulty; and when shot, frequently break with the fall. They continue about three weeks, and retire by that time Rice begins to harden.[3]

Wilson says these birds are looked upon by the careful planter as a devouring scourge, and worse than a plague of locusts. In disputing the assertion that they were unknown in this part of the continent previous to the introduction of rice plantations he states that the country produces an abundance of food of which they are no less fond, including insects of various kinds, grubs, May-flies, and caterpillars, young ears of indian corn, and seeds of wild rice (*Zizania aquatica*). He believes, however, that the introduction of rice, and more particularly the progress of agriculture, in this part of America has greatly increased their numbers by multiplying their sources of subsistence fiftyfold within the same extent of country.[4]

---

[1] Birds of Eastern N. A., p. 131, 1881.

[2] Birds of Pa., revised ed., p. 207, 1890.

[3] Natural History of Carolina, Vol. I, p. 14, 1731.

[4] Am. Ornith., Edinburgh ed., Vol. I, p. 219, 1831.

It is estimated that the bobolinks, with a little help from the redwings, cause an annual loss of $2,000,000 to the rice growers of the South.[1] Much of this loss is indirect, arising from the necessity of maintaining a corps of men and boys as 'bird-minders,' who patrol the fields from morning till night, firing guns or cracking whips to frighten the birds from the ripening crop. Even then it is impossible to save all the rice, and it often happens that some acres on the borders of the uncultivated marsh where the birds resort are so badly eaten that they are not worth harvesting.

As a rule, the shooting is only to frighten the birds, as the use of shot would cause as much harm to the rice as is done by the birds. The amount of powder consumed in this way is enormous. It is not uncommon to use 100 pounds per annum, and one planter who cultivates a large plantation uses 2,500 pounds in the course of a year.

Col. John Screven, of Savannah, Ga., in writing of the ravages of the ricebird (bobolink), says:

> Its invasions are ruinous to fields on which its flocks may settle, especially if the grain is in palatable condition and in fields adjacent to marshes convenient for ambush or retreat. Bird-minders, armed with muskets and shotguns, endeavor by discharges of blank cartridges to keep the birds alarmed and to drive them from the field. Small shot are also fired among them, and incredible numbers are killed; but all such efforts will not prevent great waste of grain, amounting to a loss of large portions of a field—sometimes, indeed, to its entire loss. The voracity of the birds seems so intense that fear is secondary to it, and they fly, when alarmed, from one portion of the field to another, very little out of gunshot, and immediately settle down to their banquet. * * * The preventives in use against the ravages of the ricebirds have been already suggested, but they are palliative only, applied at great expense, and without commensurate results. * * * In short, no effort yet tried consistent with reasonable economy will drive the ricebird from the field or afford any well-founded promise of their reduction to harmless numbers.

A more specific case of damage is that of a field mentioned by Mr. J. A. Hayes, jr., of Savannah, Ga., which consisted of 125 acres of rice that matured when birds were most plentiful, and which, in spite of 18 bird-minders and 11 half kegs of gunpowder, yielded only 18 bushels per acre of inferior rice, although it had been estimated to yield 45 bushels.

Capt. William Miles Hazzard, of Annandale, S. C., says:

> During the nights of August, 21st, 22nd, 23rd, and 24th, millions of these birds make their appearance and settle in the rice fields. From August 21st to September 25th our every effort is to save the crop. Men, boys and women are posted with guns and ammunition to every four or five acres, and shoot daily an average of about one quart of gunpowder to the gun. This firing commences at first dawn of day, and is kept up until sunset. After all this expense and trouble our loss of rice per acre seldom falls under five bushels, and if from any cause there is a check to the crop during its growth which prevents the grain from being hard but in a milky condition, the destruction of the rice is complete—not paying to cut and bring out of

[1] Report of Department of Agriculture for 1886, p. 247.

the field. We have tried every plan to keep these pests off our crop at less expense and manual labor than we now incur, and have been unsuccessful. Our present mode is expensive, imperfect and thoroughly unsatisfactory, yet it is the best we can do.

Mr. R. Joseph Lowndes, of Annandale, S. C., in writing of the bobolink and redwing, says:

I think I am in bounds when I say that one-fourth, if not one-third of the [rice] crop of this river [the Santee] is destroyed by birds from the time the seed is put into the land till the crops are threshed out and put in the barns—I shoot out about 100 kegs of powder every September, with a fair quantity of shot, say 30 to 50 bags, and have killed as high as 150 dozen in a day. In the bird season it takes every man and boy on the plantation to mind these birds. This work has to go on from daylight till dark in any and all weathers and at great expense for six weeks in the fall before the rice is ripe enough for the sickle, and then on till we can get it out of the fields. These birds, if not carefully minded, will utterly destroy a crop of rice in two or three days.

Mr. A. X. Lucas, of McClellanville, S. C., says:

The annual depredations of the birds are in my opinion equal in this section to the value of the rent of the land—to say nothing of the expense of minding the birds.

Many similar reports of the bobolink's damage to rice have been received by the Biological Survey from Southern rice growers. So destructive are the attacks of these birds that it is necessary to plant the rice previous to their coming in the spring, so that it can be under water when they arrive, and then to plant another lot when they have passed on to the north. This method is adopted not only to avoid the full extent of the ravages of the birds in the spring, but also that the first lot may mature in the fall before the birds return, and the second after they have passed on to their winter home. But it frequently happens that one of the crops is 'in the milk' when the birds arrive in August, in which case it is almost impossible to save it from total destruction.

Mr. Allen C. Zard, of White Hill, S. C., says that when rice is so planted as to 'meet the birds,' that is, to be in just the right stage of maturity when they arrive, and they come in full force, they will destroy the whole crop in spite of powder and shot or anything else.

As a sample of actual loss, the following statement, furnished by Colonel Screven, gives his account with the bobolink at Savannah, Ga., for the year 1885:

Cost of ammunition	$245.50
Wages of bird minders	300.00
Rice destroyed, say 400 bushels	500.00
	$1,045.50

Colonel Screven cultivated in that year 465 acres of tidal land, so that he has estimated a loss of less than 1 bushel of rice to the acre, while most of the rice growers estimate the loss at from 4 to 5 bushels.

Captain Hazzard states that in cultivating from 1,200 to 1,400 acres of rice, he has paid as much as $1,000 for bird-minding in one spring.

In addition to the use of firearms, various other methods of avoiding the ravages of the ricebirds have been tried, but with, at best, indifferent success. To prevent the birds from pulling up the sprouted seed in spring the device of coating it with coal tar has been used, as is effectively practiced in the case of corn. But the method of rice culture is very different from that of corn. As soon as the rice is sown it is covered with water, which remains on the field until the germination of the seed, a period of variable length. The soaking in water so affects the tar coating that it no longer protects the grain, and when the water is withdrawn the birds at once attack the seed. Moreover, it is stated by Captain Hazzard that some birds, including the ricebird, hull the grain before eating it, an assertion apparently corroborated by the absence of hulls in the bobolink stomachs examined that contained rice. (When seeds are swallowed by birds, the hulls usually remain longer in the stomachs than the kernels.) Hence, on this account also, the tar coating would probably have no preventive effect. Another method is to attach small flags to stakes or to fly kites over the fields. Looking-glasses have also been suspended in the same way, but all these devices soon cease to be effective. Placing pieces of refuse meat on poles about the fields to attract the buzzards has been tried; the ricebirds mistake the buzzards for hawks and avoid the fields over which they are flying. But the scheme is effective only for a short time, as the birds soon become accustomed to the presence of the buzzards and pay no further attention to them.

These facts and figures are presented for the consideration of the people of the Northern States, to whom the name 'bobolink' suggests only poetry and sentiment, and by whom the birds themselves are looked upon as almost sacred, and are rigidly protected. It is not probable that any farmer in the North will for a moment contend that he receives from the bobolinks that nest upon his farm so much benefit that he would be willing in return to share the losses inflicted upon his Southern brothers by the birds.

Insect pests ravage the crops of the whole country. No section is exempt from damage. Each crop has its destroyers, against which human energy and science must contend with whatever success they may, and in most cases some effectual remedy has been devised. But the case of the attacks of the bobolink upon the rice crop of the South is unique and is probably the result of a peculiar combination of causes.

As before stated, these birds are inhabitants of open fields; meadows and prairies form their ideal breeding grounds. So much do they avoid woods and groves that they will seldom nest in a well-grown orchard, even if other accompaniments are agreeable. At the time

America was first settled, the whole northeastern part of the country must have presented but few localities, and those of limited area, suited to their wants. When the great forests of New England and New York were cleared away and transformed into farms with extensive areas of mowing land intersected with springs and brooks, the bobolinks were not slow to avail themselves of these new opportunities and soon colonized the whole. At the same time the southeastern coast region was also brought under cultivation, and the tidal and river lands were devoted to the raising of rice, thus furnishing the food needed for the augmented numbers, as noted by Wilson. As settlement, with its attendant clearing away of forests, spread westward, suitable nesting areas were continually added to those already created, and the birds had abundant opportunity for great increase in numbers.

Since the bobolinks pass the winter in South America, the southern coast of Florida naturally presents to most of them the point of departure for the long sea flight to their winter homes. Before reaching this spot, however, they stop to rest and feed in the rice fields of the Southeast, where they remain and recruit their exhausted energies preparatory to final migration. A small contingent, representing those that have nested in the extreme western portion of their range, migrate directly down the Mississippi Valley to the rice fields of Louisiana. When the birds arrive from the North they are in poor condition, having been debilitated by the exertion of reproduction, but they at once begin to recuperate with the abundant food furnished by the rice, soon become very fat, and, after a few weeks' rest, are able to safely resume the southern journey. On the return migration the conditions are similar; the birds arrive from their winter home tired out with their long flight, and find the fields either newly sown with rice or else with the tender blade just appearing above the ground. In each case there is an abundant supply of food, and they are soon in condition to pursue the journey to their northern breeding ground.

Here we see the two causes which have combined to bring about all the trouble between the rice planters and the bobolinks: (1) The fact that the species has probably much increased through the extension of its northern breeding ground, and (2) the fact that the rice fields lie directly in the path of migration, and afford a convenient place for rest and recuperation before and after the flight across the sea. It is almost certain that if the rice fields were far outside of the lines of migration, they would never be molested. It is probable that long before America was discovered the bobolinks gathered in the marshes on the southeastern coast and fed upon wild rice and other wild plants previous to departure for their winter home. Cultivation of the land introduced a more abundant supply of food in the South just at the time it afforded a great increase in nesting area in the North.

In view of the fact that the food habits of the bird during migration are well known, attention has been directed chiefly in the present laboratory investigation to the character of the food taken on the breeding grounds. Of 291 stomachs examined (see p. 72), 231 were obtained from various points in the North, embracing nineteen States, from Massachusetts to Montana, the District of Columbia, and Ontario. They were taken in the five months from May to September, inclusive, but the majority of the September birds whose stomachs have been examined may be regarded as belated migrants. The food for these five months was found to consist of 57.1 percent animal matter and 42.9 percent vegetable. This result would be rather surprising but for the fact that only two of the May and nine of the September stomachs were collected in the rice fields. The general character of the food during the five months is shown in the accompanying diagram (fig. 2).

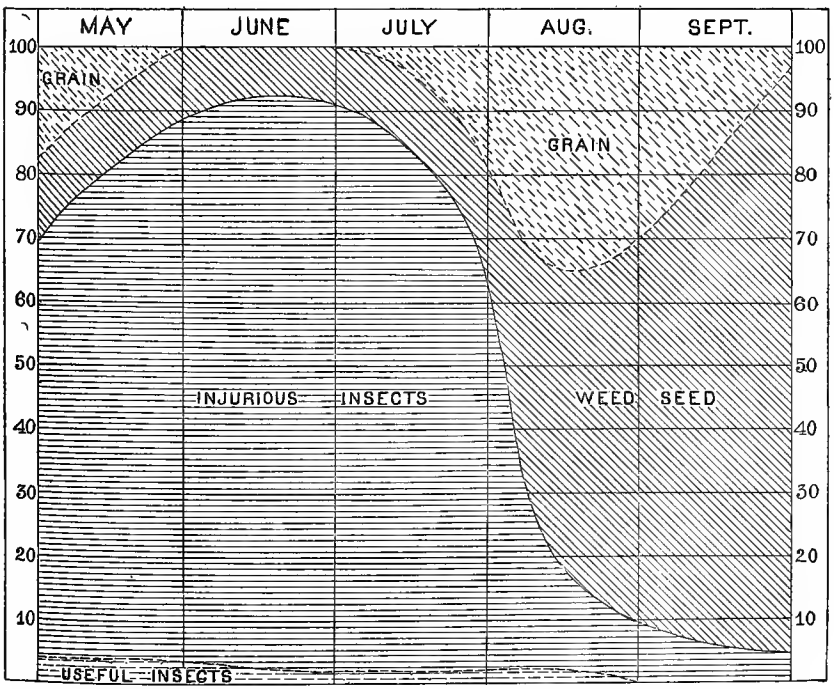


FIG. 2.—Diagram showing proportions of animal and vegetable food of bobolink in each month from May to September inclusive. (The figures in the margins indicate percentages.)

Of the insect food, as determined by the examination, beetles constitute nearly 19 per cent. Predaceous species (Carabidæ), which are, broadly considered, useful insects, are represented only by a trace; snout-beetles, or weevils (Rhynchophora), amount to 8.9 percent, and in May to 20.8 percent; and other beetles, of various families, and all

of a more or less harmful character, make up the rest of the coleopterous food. Hymenoptera, represented by ants and some wasps, and by many of the small parasitic species, form 7.6 percent of the food, and were found mostly in May and July stomachs. The bobolink eats more of these useful parasitic Hymenoptera than any other bird whose food habits have thus far been investigated, although it should be stated that examinations of flycatchers and other birds now in course of completion indicate that it will soon lose its position at the head of the list. Caterpillars are apparently a favorite food. They form 17.6 percent of the May food, and rise to 28.1 percent in June, after which they gradually decrease, averaging in the five months 13 per cent. Those eaten are mostly of the species known as cutworms, and include the well-known *Nephelodes violans*. Grasshoppers constitute 11.5 percent of the food, and are eaten principally in June and July, when they amount to 23.2 and 25.8 percent respectively. This is unusual. There seems to be a pretty general law that all birds, no matter what their food habits may be during the rest of the year, eat grasshoppers in August, just as the human race eats certain delicacies in their respective seasons. But in August, when with most birds the grasshopper season is at its height, the bobolinks begin to drop their animal diet and eat vegetable food in preparation for the rice season in the South. Besides the insects already mentioned, a few bugs and flies are eaten, and also some spiders and myriapods.

Of the vegetable food, 8.3 percent consists of oats, most of which are consumed in August, when they reach 31.4 percent of the whole food for the month. Besides oats and rice, little grain is eaten. Wheat and barley were found in a few stomachs, and buckwheat in one. Corn was not found. Weed seeds, such as barngrass, panicgrass, smartweed, and ragweed, are eaten to the extent of 16.2 percent of the food, and like oats are taken mostly in August, when they amount to 36.9 per cent. Various other articles of vegetable food go to make up the diet of the bobolinks, while they remain in the North, the most important of which is wild rice, which seems to be the favorite food during the journey to the rice plantations. This plant is as aquatic as its cultivated relative, and abounds along all the bays, estuaries, and rivers of the Atlantic coast, where it affords food for millions of birds of many species in the latter part of August and during September and later. It was originally, no doubt, the principal food of the bobolinks at this season, and remained so until the advent of civilization introduced something that the birds found even more to their taste. Of the two birds taken in the rice fields in May, one had eaten 55 percent of insects and 45 percent of rice, with a trace of weed seed, while the other had eaten 50 percent of insects, 25 percent of rice, and 25 percent of weed seed. Of the insects, 41 percent in one stomach and 30 in the other were snout-beetles (Rhynchophora). The remainder were harmful beetles of other kinds and

caterpillars, except 3 percent of predaceous beetles (Carabidæ) in one stomach and 15 percent of parasitic Hymenoptera (Ichneumonidæ) in the other. Of the nine birds shot in the rice fields in September, one had eaten 15 percent of insects and another 90 percent. The other seven had taken no animal matter, but one had eaten 10, and another 70 percent of weed seed (*Rumex*). All the other food, about 79 percent of the whole, was rice.

SUMMARY.

In a summary of its food habits this species must be treated differently from other birds. It is not enough merely to sum up the noxious insects and weeds destroyed and set them on one side of the account, with the valuable grain eaten on the other, and then strike a balance; though even in this case we should probably decide against the bird, or at least be forced to say, as of the redwing, that its harmfulness is due to an excess of individuals. The case of the bobolink is peculiar. If it preyed upon all kinds of grain or upon any one kind whose cultivation was more general, like wheat or oats, its ravages would be more widely distributed and would consequently fall less heavily upon the individual cultivator; and the damage, although the same, would be more evenly divided and so less appreciated. But instead of this, the attacks of the whole species are directed upon a single crop, and one which is grown over a very limited area and by comparatively few cultivators. Again, unlike most species that remain in the South during the winter and subsist to a great extent upon scattered waste grain, the bobolink makes its attacks at planting time and at or immediately before the full tide of harvest—just when it is capable of doing the greatest damage. The redwing, although it eats rice at harvest, remains through the winter, eating the waste rice, which, if left upon the field, would become what is called 'volunteer' rice—an undesirable element of the crop; but the bobolink in its relations to the rice field has not a single redeeming trait. What aggravates the case is the fact that the birds do not need the rice. There is no reason to suppose that if rice culture were entirely abandoned there would be any diminution in the number of bobolinks. It is altogether probable that if this source of food were withdrawn there would be enough other seed-bearing plants to supply their needs. Bird food is almost always superabundant. It is only under very exceptional circumstances that birds suffer seriously from hunger.

What, then, shall we say of the bobolink? In the life of the writer this bird is associated with some of the happiest and brightest hours of childhood, youth, and maturity. A sunny June morning in rural New England would hardly be complete without the bubbling, gushing, rollicking melody of the bobolink in the mowing lot. But hard

facts can not be set aside by poetry and sentiment. The picturesqueness of the bobolink and the melody of its song do not offset the financial loss and harassing care of the Southern rice growers. As the case stands at present the harm done by the bird far outweighs its benefits; but it is to be hoped that science may devise some means by which the rice growers may be relieved from some portion, if not all, of the labor and expense now incident to saving their crops from its devastations.

The following table shows the percentage of each of the principal kinds of food for each month from May to September.

Food of the bobolink.

[NUMBER OF STOMACHS EXAMINED: May, 52; June, 41; July, 45; August, 103; September, 50. Total, 291.]

Food.	May.	June.	July.	August.	September.	Average.
ANIMAL.	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*
Predaceous beetles	1.0	0.7	.....	1.3	.....	0.6
May-beetle family	12.1	1.5	.....	[1] Tr.	.....	2.7
Snout-beetles	20.8	9.6	9.6	2.5	2.2	9.0
Other beetles	8.6	12.8	10.7	1.4	0.1	6.7
Wasps, ants, etc	15.5	5.0	13.6	3.5	0.3	7.6
Caterpillars	17.6	28.1	15.3	2.3	1.8	13.0
Grasshoppers	[1] Tr.	23.2	25.8	6.0	2.5	11.5
Other insects	3.5	9.0	8.4	2.0	0.2	4.6
Spiders and myriapods	2.8	2.5	1.1	0.4	.....	1.4
Total animal food	81.9	92.4	84.5	19.4	7.1	57.1
VEGETABLE.						
Oats	5.3	.....	3.4	31.4	1.6	8.3
Other grain	1.7	.....	0.1	4.3	14.6	4.1
Weed seeds	10.0	6.4	9.6	36.9	18.1	16.2
Other vegetable food	1.1	1.2	2.4	8.0	58.6	14.3
Total vegetable food	18.1	7.6	15.5	80.6	92.9	42.9

[1] Tr. = trace.

THE COWBIRD.

(*Molothrus ater.*)

Few rural sights are more suggestive of quiet enjoyment than a group of cows lying at ease in a sunny pasture calmly chewing the cud, while on their backs a small flock of cowbirds are resting or walking slowly about searching for food. Why the birds choose such companions is difficult to explain, as there does not appear to be any special relation between them, but their association with domesticated animals is a matter of common observation, and has given rise to their popular name. Both Audubon and Wilson ascribe the habit to the desire of the birds to feed upon the intestinal worms they find in the cow droppings.[1] But stomach examination, however, entirely fails

[1] Ornith. Biog., Vol. I, p. 498, 1831. Am. Ornith., Edinburgh ed., Vol. I, p. 209, 1831.

to bear out this supposition. The insects that annoy the animals do not constitute any considerable portion of the cowbird's food, nor are the seeds upon which it subsists found to any particular extent where cattle range. As the cowbird is abundant in the Mississippi Valley and on the Great Plains, it would be interesting to know if it formerly associated on familiar terms with the buffalo, and such would seem to be the case, as Major Bendire gives 'buffalo bird' as one of its former names.[1]

The cowbird ranges from the Atlantic to the Rocky Mountains and sparingly beyond nearly to the Pacific, and from the Gulf of Mexico northward into southern Canada. It breeds throughout its range, except in the immediate vicinity of the Gulf.

In winter most of the birds leave the United States and pass into northern Mexico, but a few remain in the Southern States and stragglers may occasionally be found farther north. The southward movement begins in September, and by November 1 the birds have left the Northern States. On their return in spring they appear in the Middle States in March, and by the first week in May have covered their whole summer range. Their great center of abundance is the Mississippi Valley, where they are among the commonest species and second to few in point of numbers. It is a well-known fact that the cowbird, like the European cuckoo, but unlike most other birds, builds no nest for its eggs and young, but saddles the labor of rearing its progeny upon other species into whose nests it introduces its eggs. The birds it selects for this imposition are mostly species smaller than itself, and such as nest in bushes and hedges, or near the borders of woodland; for as the cowbirds inhabit the open country they will not penetrate the depths of the forest. Most of the birds thus imposed upon accept the charge, however reluctantly, and rear the intruder. As the cowbird's egg usually hatches before the eggs of the owner of the nest, the young cowbird begins at once to grow and crowds out, or prevents further incubation of, the other eggs; or, if they are hatched, so monopolizes the food supply that the young soon perish of starvation. This has been observed many times, but whether it is the universal rule has not yet been demonstrated. It is supposed that a female cowbird deposits but one egg in a nest, and that where more than one strange egg is found they are the product of different birds. As many as seven cowbird eggs have been found in one nest. A few birds actively resent the intrusion of the strange egg, and either desert the nest entirely, or build up its sides and lay a new floor, beneath which the unwelcome present is left to decay. This device has, in some cases, been used twice in the same nest, a three-storied structure resulting, in the upper story of which the rightful occupants were finally reared. The sparrows, warblers, and flycatchers are the

[1] Rept. U. S. National Museum for 1893, p. 591, 1895.

species most frequently imposed upon, but occasionally larger ones are victimized. Major Bendire enumerates 90 species in whose nests the cowbird's eggs have been found. The largest of these are the mourning dove (*Zenaidura macroura*) and the meadowlark (*Sturnella magna.*)[1] That this parasitic habit is injurious to other species there is no reason to doubt, but the extent of the injury has never been accurately determined.

It was partly with the expectation of finding some points in the cowbird's character to offset, to some extent, its parasitism that an investigation of its food habits was undertaken. The subject of its food has not attracted much attention from writers upon ornithology; for no great destruction of grain crops has been reported against the cowbird, nor has it ever been accused of preying appreciably upon fruit or garden produce. Dr. B. H. Warren, one of the few ornithologists to make a detailed examination of its food, says:

> The food of these birds consists of seeds, grains, berries and insects. Although Cowbirds subsist to a small extent on wheat and rye, they never, I think, * * * attack these cereals when growing. The seeds of clover, timothy, fox-tailed grass, bitter-weed, etc., are included in their bill of fare; blackberries, huckleberries, cedar berries, wild cherries and the summer grape (*Vitis æstivalis*, Mz.) are eaten. They subsist to a very great extent, however, on insects; large numbers of grasshoppers, beetles, grubs and "worms" are eagerly devoured.[2]

Maj. Bendire enumerates, as among the articles of cowbird diet, ragweed, smartweed, foxtail or pigeon grass, wild rice and the smaller species of grains, berries of different kinds, grasshoppers, beetles, ticks, flies, and other insects, worms, etc., and adds: "Taking its food alone into consideration it does perhaps more good than harm."[3]

A collection of 544 stomachs has been received by the Biological Survey from twenty States ranging from Maine south to Virginia and west to Kansas and the Dakotas, and also from Tennessee, Georgia, Texas, Arizona, the District of Columbia, and Canada (see p. 73). Every month in the year is represented, though only three stomachs were taken in January. The total food found in these stomachs was divided as follows: Animal matter, 22.3 percent; vegetable, 77.7 percent. The proportions in different months are shown by the accompanying diagram (fig. 3). Only a little more than 3 percent of the stomach contents was sand or gravel—a very small amount when the large proportion of vegetable food is considered. The animal food consists almost entirely of insects and spiders, a few snails forming the exceptions. The insects comprise wasps and ants (Hymenoptera), bugs (Hemiptera), a few flies (Diptera), beetles (Coleoptera), grasshoppers (Orthoptera), and caterpillars (Lepidoptera). Wasps, ants, and flies,

[1] Rept. U. S. National Museum for 1893, p. 594, 1895.

[2] Birds of Pennsylvania, revised ed., p. 210, 1890.

[3] Life Histories of N. A. Birds, II, Special Bul. No. 3, U. S. National Museum, p. 435, 1895.

especially the last, are the insects that might be supposed to attract the birds to the cattle, but the stomachs do not show that many are eaten, for altogether they amount to less than 3 percent of the food, and the wasps and ants are the most important constituents of this percentage. The wasps are probably picked from flowers while gathering honey and the ants are collected from the ground. The destruction of the latter is a decided benefit and the former can be spared. Hemiptera are represented in the stomach by stink-bugs (Pentatomidæ), leaf-hoppers (Jassidæ), and one cicada. While some of the pentatomids are useful insects, because of their habit of preying upon others of a noxious character, many of them are serious

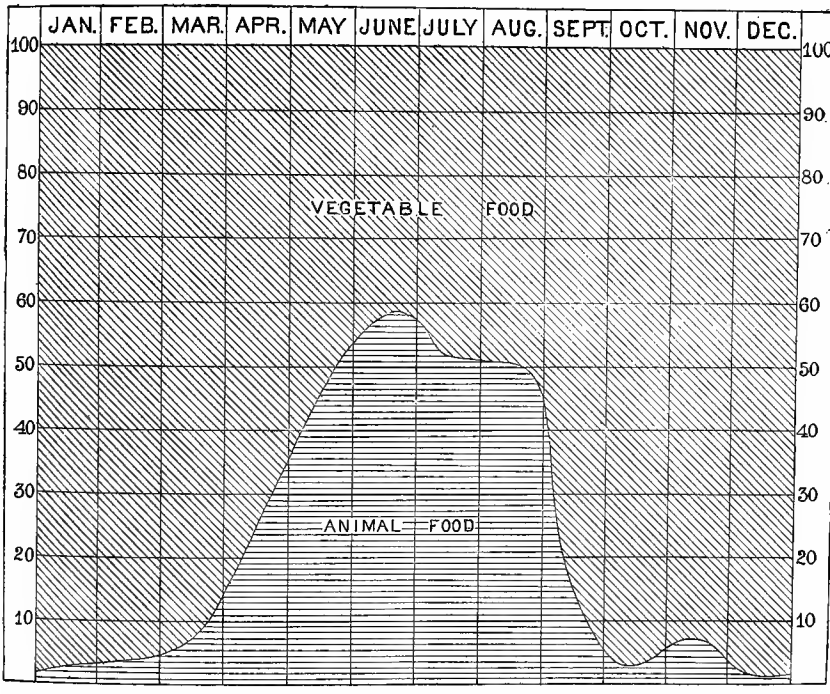


FIG. 3.—Diagram showing proportions of animal and vegetable food of cowbird in each month of the year. (The figures in the left margins indicate percentages.)

pests; so on the whole it is probable that birds do little harm by eating them. The so-called leaf-hoppers live to a great extent upon grass and might very properly be called grasshoppers were it not that that name has been appropriated for other insects. Those eaten are so little that it would require a number of them to fill the stomach of even a small bird. All are harmful, and some, as for example those that feed on the grapevine and rose, are very injurious. Cowbirds eat a great many of these leaf-hoppers, which in some stomachs amount to 60 percent of the whole contents. The greater number are eaten in June and July, but the aggregate for the year is small, about 1½ percent.

Beetles form 5.3 percent of the year's food. The predaceous ones, or those that prey to a greater or less extent on other insects (Carabidæ and a few Cicindelidæ), although living on the ground and often found by cowbirds, are rarely eaten, the aggregate for the year being about three-fourths of one percent of the whole food. Of the eight families of beetles represented in the food, only one group, the snout-beetles or weevils (Rhynchophora), are eaten to any noticeable extent, and these amount to little more than 2 percent of the food of the year, although in June they rise to more than 9 percent. They belong mostly to the families of scarred snout-beetles (Otiorhynchidæ), curculios (Curculionidæ), and 'bill bugs' (Calandridæ), and as they are all potentially harmful and most of them actual pests, their destruction is a benefit to agriculture. The rest of the beetle food, comprising species that are all more or less injurious, amounts to a little more than 2 percent, and is taken chiefly in April, May, and June.

Grasshoppers appear to be the cowbirds' favorite animal food, and compose almost half of the insect food, or 11 percent of the whole. They are first taken in March, when the birds return from their winter home, reach a maximum of 45.1 percent in August, and decrease to 6.2 percent in November. This is a large record, compared with those of most other birds whose food has been accurately determined. It is much greater than those of the crow, crow blackbird, or red-winged blackbird, all noted ground feeders, and is exceeded only by those of the meadowlark and a few of other families.

Caterpillars are eaten to some extent in every month of the cowbirds' stay in the North, but do not constitute a very important element of the food, averaging only a little more than 2 percent of the whole. The greatest number, amounting to a little more than 10 percent, are eaten in May. The notorious army worm (*Leucania unipuncta*) was identified in four stomachs, and was probably contained in many more, but not in a condition to be recognized. One small moth and one ephemerid were also found.

Spiders were found in many stomachs, but not in large numbers. They seem to be eaten wherever they are found, but probably only terrestrial species are taken. Snails were found in a number of stomachs.

Eggshells occurred in several stomachs, but in such small quantities as to preclude the probability that they were taken from the nests of other birds. When young birds are hatched the parents remove the eggshells and drop them at some distance from the nest, where, doubtless, they are found and eaten by other birds, for bits of eggshell appear more or less frequently in the stomachs of nearly every species examined.

The vegetable food of the cowbird exceeds the animal food, both in quantity and variety. When searching the ground about barnyards or roads the bird is evidently looking for scattered seeds rather than insects, though the latter are probably taken whenever found. Various

other substances are also eaten, but they are mostly of the same general character, such as hard seeds of grasses or weeds, with but little indication of fruit pulp or other soft vegetable matter. The following table shows the various grains and seeds identified, with the number of stomachs in which they were contained:

Vegetable substances found in stomachs of cowbirds.

	Stomachs.
Grain:	
Corn	56
Wheat	20
Oats	102
Buckwheat	1
Fruit:	
Blueberry (*Vaccinium*)	1
Raspberry (*Rubus*)	4
Forage:	
Clover (*Trifolium*)	8
Timothy (*Phleum*)	8
Sorghum (*Andropogon sorghum*)	2
Weeds:	
Ragweed (*Ambrosia*)	176
Knotweed (*Polygonum*)	49
Sorrel (*Rumex*)	37
Thistle (*Carduus*)	1
Amaranth (*Amaranthus*)	11
Mustard (*Brassica nigra*)	4
Chickweed (*Alsine*)	9
Weeds—Continued.	Stomachs.
Pennyroyal (*Trichostema dichotomum*)	2
Mouse-ear chickweed (*Cerastium*)	2
Plantain (*Plantago*)	1
Sunflower (*Helianthus*)	8
Gromwell (*Lithospermum*)	4
Blue-eyed grass (*Sisyrinchium bermudiana*)	1
Barngrass (*Chætochloa*)	265
Panic-grass (*Panicum*)	133
Joint-grass (*Paspalum*)	22
Yard-grass (*Eleusine indica*)	2
Unidentified (mostly unknown grass seeds)	57
Miscellaneous:	
Mast	1
Leaf gall	2
Rubbish	5

Oats are apparently the favorite grain with the cowbird, as they were found in 102 stomachs, a record which exceeds the total of those containing either wheat or corn. They first appear in March, when 12.9 per cent are eaten, evidently waste grain picked up in the stubble-fields, highways, and barnyards, except in the southern part of the country, where sowing may take place as early as this month. Oats constitute less than 2 per cent in April, nearly 8 percent in May (probably partly made up of grain from newly sown fields), 3.7 in June, 25.1 in July, 31.5 in August, 19.4 in September, and after that decrease rapidly and reach zero before the 1st of November. The average consumption for all the months of the year is 8.6 percent. Corn was found in 56 stomachs, but the irregular manner in which it is distributed through the food of the year indicates that it is not a favored diet. The record for January, which shows a little more than 33 per cent, is based on only 3 stomachs, and so can not be considered very reliable. In any case the corn eaten must have been scattered grain, unless it was some that had been left in the shock over winter. Even in October, when corn is abundant everywhere, it is scarcely touched. Only 1 bird out of 70 taken in that month had eaten any, and in this single instance it amounted to only 6 percent of the entire food. In the other months the quantity ranges downward to zero, but in such an erratic manner as to indicate that it is never sought, but merely eaten when found and when better food is not at hand. The

aggregate for the year is 6.5 percent. Wheat was found in only 20 stomachs, and amounts to 1.4 percent of the year's food. Like corn, its distribution is irregular and does not appear to have any relation to the seasons. It is probable that it is a purely accidental food, eaten only when nothing better is to be had. The greatest quantity (4.8 percent) was taken in September. A single kernel of buckwheat was found in 1 stomach.

Grain as a whole amounts to 16.5 percent, or practically one-sixth of the food of the year; but a consideration of its distribution as given above leads to the conclusion that a large portion of this, probably one-half, is waste. In comparing the record of the cowbird with that of the red-winged blackbird, the cowbird's shows the greater consumption of grain; that is, 16.5, as against 13.9 for the redwing. In view of this fact it would seem somewhat strange, were not a large proportion of the grain consumed waste, that no complaints should have been made against the cowbird on the score of grain eating. It is possible, of course, that observers have not always distinguished the two species in the field, as male cowbirds do not differ greatly in color or size from female redwings—and their great abundance in the West lends some color to this supposition. But it seems far more probable that they gather a very important part of the grain found in their stomachs in their gleaning in roads, about barnyards, and wherever cattle are found, and so do far less actual damage to growing crops than the redwings.

Fruit forms an insignificant part of the food. Some traces of what may have been fruit pulp were found, and a few seeds of raspberries were in each of 4 stomachs, and some blueberry seeds in one; but as some of the raspberry seeds were in stomachs collected in April they were evidently eaten as dry seeds, and this may have been true of all.

The seeds of plants classified as weeds in the list of vegetable food constitute by far the most important part of the diet. They form the largest item of food in every month except July and August, and are of importance in every month. Beginning with 64.4[1] percent in January and 95.5 percent in February, they slowly decrease to 16.6 percent in August, but rise suddenly to 58.1 percent in September, attain their maximum of 97 percent in October, and end with 96.8 percent in December. They constitute practically the whole food of the winter months. The aggregate for the year is 60 percent of all the food, or more than three-fourths of the vegetable food, and more than three and a half times the total amount of grain. Barngrass and ragweed are especially well known as troublesome weeds throughout the country wherever field crops are cultivated, and these two constitute the great bulk of this food. Barngrass seed was found in 265 stomachs and ragweed in 176. Panicums, while ostensibly forage plants, are often troublesome weeds. Their seeds were found in 133

[1] Based on 3 stomachs. A larger number would probably greatly increase the percentage.

stomachs, which shows that the birds relish them. Knotweed, smartweed, and other species of the genus *Polygonum*, all noted weeds, were found in 49 stomachs. The other items of the weed-seed food are eaten to a greater or less extent, but not by so many birds as are those specifically mentioned. Of the 544 stomachs only 2 were filled with grain alone, while 94 contained nothing but weed seed. The amount of weed seed destroyed by birds in a single year in the United States is immense, and it is evident that the cowbird is one of the noteworthy agents by which the already overflowing tide of noxious weeds is kept within its present limits.

SUMMARY.

In summing up the results of the investigation, the following points may be considered as fairly established: (1) Twenty per cent of the cowbirds' food consists of insects, which are either harmful or annoying. (2) Sixteen per cent is grain, the consumption of which may be considered a loss, though it is practically certain that half of this is waste. (3) More than 50 per cent consists of the seeds of noxious weeds, whose destruction is a positive benefit to the farmer. (4) Fruit is practically not eaten.

The following table shows the percentage of each of the principal kinds of food for every month in the year:

Food of the cowbird.

[NUMBER OF STOMACHS EXAMINED: January, 3; February, 10; March, 18; April, 83; May, 99; June, 53; July, 57; August, 38; September, 79; October, 70; November, 23; December, 11. Total, 544.]

Food.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average.
ANIMAL.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Predaceous beetles	.....	.....	.....	1.1	3.9	1.6	1.5	.....	.....	.....	.....	0.4	0.7
Other beetles	0.3	2.4	2.4	10.2	12.3	16.5	8.1	1.7	0.8	0.1	[1]Tr.	.....	4.6
Grasshoppers	.....	.....	2.9	5.8	10.7	20.3	29.7	45.1	9.4	1.8	6.2	.....	11.0
Caterpillars	1.3	1.3	2.1	5.2	10.3	3.8	2.2	0.3	0.3	[1]Tr.	.....	.....	2.2
Other insects	0.7	0.6	1.0	0.8	2.4	9.8	7.2	2.4	2.2	[1]Tr.	0.1	0.3	2.3
Spiders and myriapods	.....	0.2	.....	2.5	2.2	4.8	2.9	0.9	0.3	[1]Tr.	.....	.....	1.1
Other animal food	.....	.....	0.2	0.1	0.9	2.3	0.5	0.1	[1]Tr.	.....	.....	.....	0.4
Total animal food	2.3	4.5	8.6	25.7	42.7	59.1	51.9	50.5	13.0	1.9	6.3	0.7	22.3
VEGETABLE.													
Grain	33.3	.....	31.3	7.1	15.7	12.9	27.2	31.7	28.9	1.1	6.1	2.5	16.5
Weed seeds	64.4	95.5	49.1	66.1	41.5	28.0	19.2	16.6	58.1	97.0	87.6	96.8	60.0
Other vegetable food	.....	.....	11.0	1.1	0.1	.....	1.7	1.2	.....	.....	.....	.....	1.2
Total vegetable food	97.7	95.5	91.4	74.3	57.3	40.9	48.1	49.5	87.0	98.1	93.7	99.3	77.7

[1]Tr. = trace.

In view of the fact that so much has been said in condemnation of the cowbird's parasitic habits, it may not be out of place to inquire whether this parasitism is necessarily as injurious as has been claimed. When a single young cowbird replaces a brood of four other birds, each of which has food habits as good as its own, there is, of course, a distinct loss; but, as already shown, the cowbird must be rated high in the economic scale on account of its food habits, and it must be remembered that in most cases the birds destroyed are much smaller than the intruder, and so of less effect in their feeding, and that two or three cowbird eggs are often deposited in one nest.

The question is a purely economic one, and until it can be shown that the young birds sacrificed for the cowbirds have more economic value than the parasite, judgment must be suspended.

THE YELLOW-HEADED BLACKBIRD.

(*Xanthocephalus xanthocephalus.*)

The yellow-headed blackbird is locally distributed throughout the Western United States, where it frequents marshes and sloughs, but avoids the more arid deserts, extensive forests, and wooded mountains. Its range in summer extends from southern California through northern Arizona and New Mexico to Indiana, and northward into the Canadian Provinces. It winters in the southern part of its range and on the table-lands of Mexico. Stragglers have been found from Greenland to Cuba.

Its breeding habits are much like those of the redwing, but it is usually less abundant than that bird. It is gregarious and resorts to marshes to build its nest, which is very similar to that of the redwing, and similarly placed. Although it breeds in marshes, it does not by any means confine itself to them in its search for food, but forages far afield, visiting cornerib, grainfields, and barnyards. The writer's first experience with the yellow-headed blackbird was on the prairies of Nebraska, where flocks visited the railway then in process of construction, running about among the feet of the mules and horses in search of grubs and worms exposed by the plow and scraper, and all the time uttering their striking gutteral notes (almost precisely like those of a brood of suckling pigs). In their habit of visiting barnyards and hog pastures they resemble cowbirds much more than redwings. When the breeding season is over they often visit grainfields in large flocks, and become the cause of much complaint by Western farmers.

The investigation of their food is founded upon an examination of 138 stomachs received from ten of the Mississippi Valley States, and from California and Canada, and collected during the seven months from April to October, inclusive (see p. 73). While decidedly too few to give entirely reliable results, they may furnish some preliminary

data regarding the food. As indicated by the contents of these stomachs, the food for the seven months consists of 33.7 percent of animal (insect) matter and 66.3 percent of vegetable matter. The animal food is composed chiefly of beetles, caterpillars, and grasshoppers, with a few of other orders, while the vegetable food is made up almost entirely of grain and seeds of useless plants. Predaceous beetles (Carabidæ) constitute 2.8 percent of the season's food, a very small amount for a bird of such pronounced terrestrial habits. Most of these beetles are eaten in May, June, and July, and none are taken in the fall months. Other beetles amount to a little more than 5 percent, and are eaten mostly in the early part of summer. Caterpillars constitute 4.6 percent, but nearly two-thirds of them are taken in July, and in that month they form 21.5 percent of the month's food. Remains of the army worm (*Leucania unipuncta*) were identified in 6 stomachs. Grasshoppers are first eaten in May, but do not amount to any important percentage until July, the month of maximum consumption. In this respect this bird appears to differ, like the bobolink, from most other species, as August is usually the month in which grasshoppers are eaten most freely; but the examination of a larger number of stomachs might prove the yellowhead to be no exception to the usual rule. After August the consumption of grasshoppers is considerably increased, and the total for the season is 11.6 percent. The remainder of the animal food, 9.7 percent, is made up of other insects, chiefly Hymenoptera (ants, wasps, etc.), with a few dragonflies and an occasional spider and snail.

So far as its animal food is concerned, the yellowhead has a very good record. For a ground feeder, it takes very few predaceous beetles, while insects harmful to vegetation constitute 30 percent of its food.

The vegetable food consists almost entirely of seeds, and for economic purposes may be divided into grain and weed seed. Of grain, oats hold first place, as in the food of the redwing, and are probably eaten in every month when they can be obtained, although none were found in any of the 5 stomachs taken in September. The 3 October stomachs contained an average of 63 percent, but a greater number of stomachs would in all probability give a smaller average. August, apparently the next month of importance, shows 43.2 percent. Next to oats corn is the favorite grain, and was eaten to the extent of 9.8 percent, nearly all in the months of April, May, and June, with a maximum of 48.8 percent in April, when no wheat was eaten. Wheat appears from May to August, inclusive, and is the only vegetable food that reaches its highest mark in August. The average for the season is 3.5 percent.

Grain collectively amounts to 38.9 percent, or considerably more than half of the total vegetable food, and more than one-third of all

the food. While there is no doubt that a considerable quantity of this is waste, still a very decided taste for grain is shown, a point that is more especially emphasized by the large quantity (more than 54 percent of the total food) eaten in August. Corn, from its appearance in such large quantities in the food of the early spring months, is evidently picked up as waste grain to a considerable extent, but oats and wheat, which appear at the same time, are probably largely taken from newly sown fields. In July and August they evidently come from harvest fields. Mr. E. W. Nelson, of the Biological Survey, informs the writer that from about the last of August to the end of September the cornfields of the table-lands of Mexico are much damaged by yellowheads.

Weed seed appears as a very prominent item of food in every one of the seven months under consideration, except October, the record for which is based on only 3 stomachs and hence can not be made a basis for sound conclusions. Beginning with 18 percent in April, it increases to 34 percent in June, drops to 6.6 in July (to make room for caterpillars and grasshoppers), rises to 36.1 percent in August, and finally to 64.4 percent in September. While, as stated above, none was found in the 3 October stomachs, there is no reason to doubt that weed seed is not only a common article of food in that month but also a staple diet in the other colder months of the year. It is to be regretted that no stomachs of the yellowhead have been received from its winter range, to give some idea of its food during the colder season. It is almost certain, however, that this would be found to consist of weed seed and waste grain, as in the case of its neighbor, the redwing. The weeds found in the stomachs are almost precisely the same as those eaten by the redwings, and in practically the same proportions. Barngrass (*Chætochloa*), *Panicum*, and ragweed (*Ambrosia*) are the leading kinds, supplemented by *Polygonum*, *Rumex*, and others.

SUMMARY.

From this brief review some conclusions may be drawn, but the somewhat fragmentary nature of the evidence makes it probable that they may be subject to considerable modification in future. It is almost certain that the rather peculiar distribution of the various items of food through the season will prove to be more apparent than real in the light of more extensive observations. In the meantime we may safely conclude (1) that the yellowhead feeds principally upon insects, grain, and weed seed, and does not attack fruit or garden produce; (2) that it does much good by eating noxious insects and troublesome weeds, and (3) that where too abundant it is likely to be injurious to grain.

When it is considered that the redwing has been accused of doing immense damage to grainfields, it is evident that the yellowhead, which

has been found to eat nearly three times as much grain as the former, must be capable of much mischief in localities where it becomes superabundant.

The following table shows the various elements of the food for each month of the season:

Food of the yellow-headed blackbird.

[NUMBER OF STOMACHS EXAMINED: April, 9; May, 31; June, 14; July, 16; August, 60; September, 5 October, 3; total, 138.]

Food.	April.	May.	June.	July.	August.	September.	October.	Average.
ANIMAL.	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*	*Percent.*
Predaceous beetles	2.7	8.0	4.1	4.7	0.1	.....	.....	2.8
Other beetles	3.9	12.6	7.8	7.8	0.7	.....	2.3	5.0
Caterpillars	0.1	6.0	4.4	21.5	0.1	.....	.....	4.6
Grasshoppers	.....	1.0	0.4	32.0	8.0	15.6	24.3	11.6
Other insects	2.6	5.3	22.6	6.9	0.8	19.0	10.4	9.7
Total animal food	9.3	32.9	39.4	72.9	9.7	34.6	37.0	33.7
VEGETABLE.								
Corn	48.8	9.0	9.7	.....	1.1	.....	.....	9.8
Wheat	.....	5.7	3.4	5.8	9.9	.....	.....	3.5
Oats	23.9	21.9	12.8	14.4	43.2	.....	63.0	25.6
Weed seed	18.0	30.5	34.0	6.6	36.1	64.4	.....	27.1
Other vegetable food	.....	.....	0.7	0.3	.....	1.0	.....	0.3
Total vegetable food	90.7	67.1	60.6	27.1	90.3	65.4	63.0	66.3

THE RED-WINGED BLACKBIRD.

(*Agelaius phœniceus.*)

The red-winged blackbird (otherwise known as the red-shouldered blackbird, swamp blackbird, and American starling), including its various races,[1] inhabits North America from Nova Scotia and Great Slave Lake south to Costa Rica. It breeds throughout its range in the United States and Canada. The typical form is replaced at different places in the southern part of the range by the Bahama, Florida, and Sonoran redwings, but the differences that separate these various subspecies are scarcely appreciable by the casual observer. The bird is curiously restricted in its local distribution by the fact that it nests as a rule only in the immediate vicinity of water, and preferably directly over it. For this reason it is absent from extensive tracts of country either in high mountainous regions or in desert or forest areas. Nests have occasionally been found in perfectly dry situations at a distance from water, but such cases are exceptional.

The prairies of the Upper Mississippi Valley, with their numerous sloughs and ponds, furnish ideal nesting places for redwings, and consequently this region has become the great breeding ground for the

[1] The different subspecies are not considered separately in this bulletin.

species. In many places, especially on the borders of shallow lakes, thousands of acres of rushes and reeds of various kinds afford nesting sites for redwings, yellowheads, and marsh wrens, while myriads of more aquatic species swim in the waters below and nest amid the broken herbage. It is from such breeding grounds that the vast flocks are recruited that make such havoc upon fields of grain and call forth the maledictions of the unfortunate farmer. East of the Appalachian Range the conditions are different. Marshes on the shores of lakes, rivers, and estuaries are here the only sites available for breeding purposes, and as these are more restricted in number and area than the western breeding grounds the species is much less abundant than in the West.

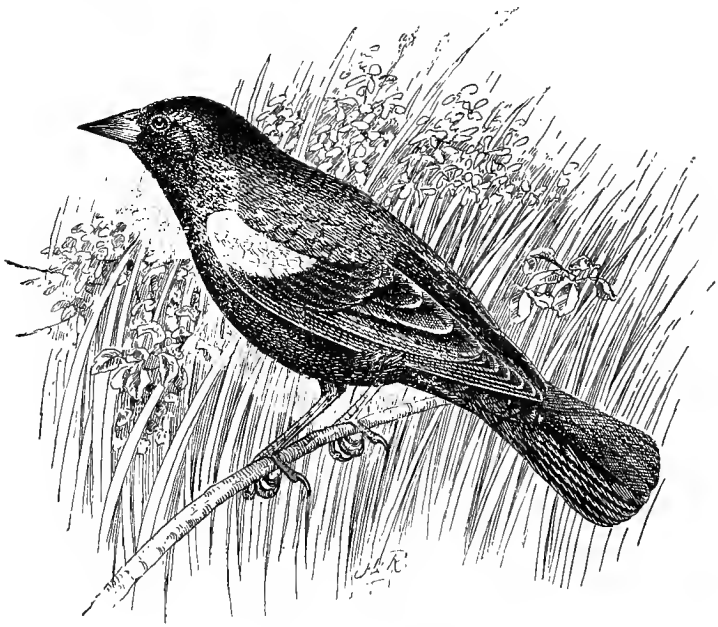


FIG. 4.—Red-winged blackbird.

Like their associates, the marsh wrens, and their neighbors, the bank swallows, the redwings are eminently gregarious, living in flocks for the greater part of the time and breeding in communities which vary in size according to the area of the swamp they occupy. Sometimes these colonies are reduced to a single family, which in such cases usually consists of one male bird with several females and their nests; for this species practices polygamy, a habit noted in the case of only a few species of song birds.

During the winter the redwings are in the South, but may occasionally be found as far north as latitude 40°, and stragglers may occur at any point within their summer range. (A young male was shot by the writer in central Iowa in January, 1879, and one bird whose stomach

is included in this investigation was killed in northern Massachusetts on January 29, 1896.) In their northward migration they begin to appear in the Upper Mississippi Valley about the last of February or during the first half of March, and by the middle of March enter the New England States. On the return journey they begin to leave the more northern portions of their range in September, and the migration is practically complete by the end of October.

Although they arrive from the South at an early date, they are by no means early breeders, for at that time the marshes are desolate wastes of dead and broken-down herbage, and the birds do not build until the new growth is considerably advanced. This involves a delay of several weeks, during which the birds, having taken possession of a marsh where they intend to construct their homes, sit idly about and behave as though time hung heavily upon them. The females usually perch upon the dead vegetation as if watching for the new growth to appear, while their liege lord, with the resplendent insignia of his rank conspicuous on his shoulders, struts about upon some fence or tree and swells his little body, ruffles up his feathers, and by a display of his brilliant colors and a rather poor attempt at singing tries to make the time less wearisome to his patient mates.

Owing to their peculiar nesting habits these birds do not come in contact with the farmers' crops appreciably during the breeding season, since at this time they confine themselves to the immediate vicinity of their marshy homes. After the season of reproduction they assemble in flocks, usually of a considerable size and often immense, and it is at this time that they frequently do serious harm to crops of standing grain. Much testimony has been received by the Department of Agriculture indicating that the damage is sometimes enormous. In letters received from the rice growers in the South the redwing is implicated equally with the bobolink in destroying rice both in spring and fall. It is claimed by some, however, that the redwing is not wholly bad, as it remains in the fields during the winter and eats the 'volunteer' rice, which, if it grew in any considerable quantity, would spoil the crop.

On the other hand, there is considerable evidence that redwings eat a great many insects, and that it is only under exceptional circumstances that they eat grain to an injurious extent. It is noticeable that nearly all complaints against them come from the Mississippi Valley, where the native grasses and weeds of the prairies have been replaced by vast fields of grain. It has also been stated that the greatest damage was done when but few fields of grain had been planted. These afforded a new and easily accessible supply of food of which the birds were not slow to avail themselves; but since the grainfields have increased in area the work of the birds has become more widely distributed, and the damage has not been so apparent.

Wilson, in speaking of the food of the redwing, says:

The whole season of winter, that, with most birds, is passed in struggling to sustain life in silent melancholy, is, with the redwings, one continued carnival. The profuse gleanings of the old rice, corn, and buckwheat fields, supply them with abundant food, at once ready and nutritious. * * * Before the beginning of September, these flocks have become numerous and formidable; and the young ears of maize, or Indian corn, being then in their soft, succulent, milky state, present a temptation that can not be resisted. Reenforced by numerous and daily flocks from all parts of the interior, they pour down on the low countries in prodigious multitudes. Here they are seen, like vast clouds, wheeling and driving over the meadows and devoted cornfields, darkening the air with their numbers. Then commences the work of destruction on the corn, the husks of which, * * * are soon completely or partially torn off; while from all quarters myriads continue to pour down like a tempest, blackening half an acre at a time; and, if not disturbed, repeat their depredations till little remains but the cob and the shriveled skins of the grain; what little is left of the tender ear, being exposed to the rains and weather, is generally much injured. * * *

It has been already stated, that they arrive in Pennsylvania late in March. Their general food at this season, as well as during the early part of summer, * * * consists of grubworms, caterpillars, and various other larvæ, the silent, but deadly enemies of all vegetation, and whose secret and insidious attacks are more to be dreaded by the husbandman than the combined forces of the whole feathered tribes together. For these vermin, the starlings search with great diligence; in the ground, at the roots of plants, in orchards, and meadows, as well as among buds, leaves, and blossoms; and from their known voracity, the multitudes of these insects which they destroy must be immense. Let me illustrate this by a short computation: If we suppose each bird, on an average, to devour fifty of these larvæ in a day, (a very moderate allowance,) a single pair, in four months, the usual time such food is sought after, will consume upward of twelve thousand. It is believed, that not less than a million pair of these birds are distributed over the whole extent of the United States in summer; whose food, being nearly the same, would swell the amount of vermin destroyed to twelve thousand millions. But the number of young birds may be fairly estimated at double that of their parents; and, as these are constantly fed on larvæ for at least three weeks, making only the same allowance for them as for the old ones, their share would amount to four thousand two hundred millions; making a grand total of sixteen thousand two hundred millions of noxious insects destroyed in the space of four months by this single species! The combined ravages of such a hideous host of vermin would be sufficient to spread famine and desolation over a wide extent of the richest and best cultivated country on earth. All this, it may be said, is mere supposition. It is, however, supposition founded on known and acknowledged facts. I have never dissected any of these birds in spring without receiving the most striking and satisfactory proofs of these facts; and though, in a matter of this kind, it is impossible to ascertain precisely the amount of the benefits derived by agriculture from this, and many other species of our birds, yet, in the present case, I can not resist the belief, that the services of this species, in spring, are far more important and beneficial than the value of all that portion of corn which a careful and active farmer permits himself to lose by it.[1]

Audubon, in speaking of this species, says:

The marsh blackbird is so well known as being a bird of the most nefarious propensities, that in the United States one can hardly mention its name, without hearing such an account of its pilferings as might induce the young student of nature to conceive that it had been created for the purpose of annoying the farmer. That it

destroys an astonishing quantity of corn, rice, and other kinds of grain, cannot be denied; but that before it commences its ravages, it has proved highly serviceable to the crops is equally certain. * * *

Their food at this season [spring], is almost exclusively composed of grubs, worms, caterpillars, and different sorts of coleopterous insects, which they procure by searching with great industry, in the meadows, the orchards, or the newly plowed fields. * * * The millions of insects which the redwings destroy at this early season, are, in my opinion, a full equivalent for the corn which they eat at another period.[1]

Of more recent writers, probably Dr. B. H. Warren has made the most extensive researches upon the food habits of these birds.

In stating the results of the examination of 25 stomachs, he says:

The redwing * * * destroys large numbers of "cutworms." I have taken from the stomach of a single swamp blackbird as many as 28 "cutworms." In addition to the insects, etc., mentioned above, these birds also, during their residence with us, feed on earth-worms, grasshoppers, crickets, plant-lice and various larvæ, so destructive at times in the field and garden. During the summer season, fruits of the blackberry, raspberry, wild strawberry, and wild cherry are eaten to a more or less extent. The young, while under parental care, are fed exclusively on an insect diet.[2]

N. S. Goss says of the redwings:

During the fall and winter months they assemble in large flocks, and do much damage in the ricefields, and are often more or less injurious to the grains within their summer homes; but the damage they do in the latter case is overbalanced by the destruction of injurious insects, upon which they almost wholly feed during the breeding season; busy hunters of the field and followers of the plow.[3]

Stomach examination does not indicate that the redwings are especially fond of grain. The diagram here given (fig. 5) illustrates the variation in the relative proportions of the more important elements of the food throughout the year. The preponderance of weed seeds over grain or other vegetable food is apparent at a glance. Weed seeds, such as *Chætochloa* (*Setaria*), *Ambrosia*, *Rumex*, *Polygonum*, etc., constitute more than half the food of the year, while grain (nearly half oats) is less than one-seventh. The only varieties of *Chætochloa* that are cultivated extensively are Hungarian grass and millet, but as these are raised to a great extent as forage plants no great harm is done by taking the seed, except when it is newly sown or where the crop is raised for seed alone. The other species are all noxious weeds, and probably the greater part of the *Chætochloa* eaten by birds is from wild plants, which are as much of a nuisance as any of the other weeds when they get into cultivated fields. In the matter of fruit the redwings are almost total abstainers, only on rare occasions tasting a blackberry or some other of the smaller varieties by way of experiment.

[1] Ornith. Biog., Vol. I, pp. 348–349, 1831.

[2] Birds of Pennsylvania, revised ed., p. 212, 1890.

[3] History of the Birds of Kansas, p. 399, 1891.

The increase of vegetable food other than grain and weed seeds during August and September is due to the consumption of wild rice (*Zizania aquatica*), which at this time forms quite an important item.

In their insect diet the redwings do much good, for only a small proportion of the species they eat are beneficial. More destructive snout-beetles (weevils) are eaten by them than by any other birds that the writer has examined, with the single exception of the bobolinks. Other beetles and grasshoppers also constitute an important part of

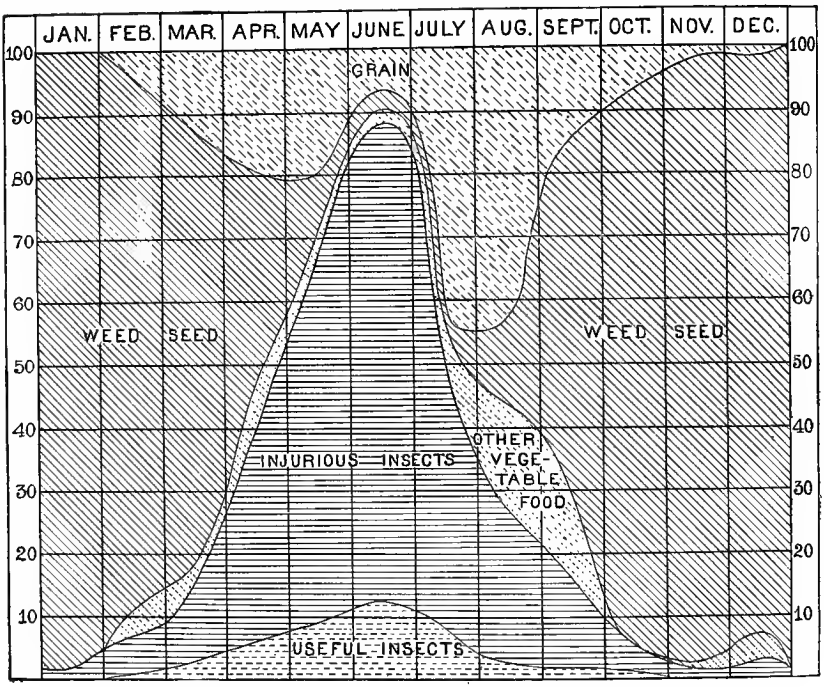


FIG. 5.—Diagram showing proportions of animal and vegetable food of red-winged blackbird in each month of the year. The relative amounts of the different kinds of food are shown by variously shaded areas. Thus, in June, useful insects are represented by the broken-lined area at the bottom of the column for that month, injurious insects by the horizontally shaded space, grain by the space shaded with diagonal broken lines, and the other elements of food in similar manner. The percentage of food (for example, of injurious insects), for a month, is not necessarily indicated by the summit of the curve, but by the space between the upper and lower curves. (The figures in the margins indicate percentages.)

the insect food. While there can be no doubt that the birds do considerable damage when collected in large flocks, it is probable that such injury will become less and less as the area of cultivation increases and the swamps where they breed are encroached upon and drained, with a consequent reduction in the abundance of the species.

The Biological Survey has examined 1,083 stomachs of the redwing, collected in every month of the year, and from thirty States, the District

of Columbia, and Canada (see p. 74). The greater number of these stomachs were collected in the Northern States during and immediately before or after the breeding season. Most of those taken in the South were collected in Texas during the winter. These throw considerable light on the winter food, which does not apparently differ greatly from that eaten in the Northern States in the early spring and late fall. No stomachs were received from the rice-growing region during sowing and harvesting.

The food of the year was found to consist of 73.4 percent of vegetable matter and 26.6 percent of animal. The animal food begins with 1.4 percent in January and gradually increases to 88.2 percent in June, after which it regularly decreases to a fraction of 1 percent in November. With the exception of a few snails and crustaceans, it consists entirely of insects and their allies (spiders and myriapods), so that, roughly speaking, insects constitute one-fourth of the year's food. They consist principally of beetles, grasshoppers, and caterpillars, with a few wasps, ants, flies, bugs, and dragon-flies.

The beetles (Coleoptera) amount to a little more than 10 percent of the food, and the greater part of them are harmful insects. They belong to several families, but only one group is eaten extensively enough to be greatly distinguished above the others. This is the suborder of snout-beetles or weevils (Rhynchophora). These constitute 4.1 percent of the year's food, but in June amount to 22.4 percent of the food of the month. All the beetles of this group are injurious, some of them greatly so. Useful predaceous beetles (Carabidæ) are eaten to the extent of 2.5 percent of the food of the year, but are taken mostly in spring and early summer. Other beetles, belonging to several families, such as click-beetles (Elateridæ), leaf-beetles (Chrysomelidæ), May-beetles (Scarabæidæ), and a few others, amount altogether to 3.5 percent.

Grasshoppers (Orthoptera) are eaten practically in every month of the year, though none were found in the 11 stomachs taken in January. They constitute 4.7 percent of the whole food, and are exceeded by no other insects except beetles and caterpillars. The greatest number (amounting to 17 percent) are eaten in August, the 'grasshopper month.' As all species of grasshoppers are injurious, their destruction must be counted to the credit of the bird.

Caterpillars (larvæ of Lepidoptera) form 5.9 percent of the year's food. They are eaten to a slight extent in the winter months and in gradually increasing amounts up to May, when they form 20 percent of the food. Their consumption falls away to almost nothing in August, when grasshoppers are plentiful, and rises again in September, showing that grasshoppers are preferred, and for a short time replace the lepidopterous food. The same fact has been shown in the case of

the Baltimore oriole, which leaves the trees in August and descends to the ground to eat grasshoppers.[1] While caterpillars are not all harmful, none of them as far as known are doing anything for the good of the farmer, so the redwings, in so far as they destroy these insects, are doing a beneficial work, and among those found in the stomachs were a number of the widely known and dreaded army worm (*Leucania unipuncta*). Miss Caroline G. Soule, in a letter from Brandon, Vt., quoted by Dr. C. M. Weed, says that the redwings, with other birds, do especially good work in destroying the pupæ of the forest-tent caterpillar, and later feed on the adult insects.[2]

Other insects, such as ants and wasps (Hymenoptera), bugs (Hemiptera), flies (Diptera), and dragon-flies (Odonata), with a few spiders and myriapods, make up the rest of the animal food, but none of them are eaten to such an extent as to render them of any striking economic importance. Ants, bugs, and flies are all more or less injurious or annoying insects, while wasps, dragon-flies, and spiders are probably for the most part somewhat useful. Dragon-flies are found about water, where the redwings also live, but they are too rapid in flight and too restless to be caught by anything less expert than a flycatcher, and it is probable that those eaten by redwings are picked up dead. Spiders are for the most part useful, but in a rather restricted way, and their destruction is not a great loss. Considered as a whole, the animal food of the redwings consists of insects, the most of which are positively harmful, while but few are decidedly beneficial.

The diagram on p. 38 shows in a striking manner the increase of the animal food in early summer—that is, in June. It is probable that the exhaustive labors of reproduction call for a more exclusively animal diet in May and June than does the strain of moulting in July and August. There seems to be no other theory by which to explain the decrease in the latter month, especially in view of the fact that these are the months when grasshoppers abound.

The vegetable food of the redwings consists mainly of seeds of grasses and weeds, the different kinds of grain being merely larger or more important grasses. Some of these plants, like wild rice (*Zizania*), have no economic importance; but many others, such as the cultivated grains, are of value, and their destruction is a positive loss; while still others, like ragweed (*Ambrosia*), are noxious weeds, the destruction of which is a benefit to the farmer. The following table shows all the vegetable substances found, with the number of stomachs in which each occurred:

[1] Yearbook Dept. of Agriculture for 1895, p. 429.

[2] Bull. 64, N. H. Agr. Coll. Expt. Sta., May, 1900.

Vegetable substances found in stomachs of red-winged blackbirds.

	Stomachs.
Grain:	
Oats	190
Corn	117
Wheat	68
Barley	2
Forage:	
Clover (*Trifolium*)	4
Sorghum (*Sorghum*)	5
Timothy (*Phleum*)	7
Weeds:	
Panic-grass (*Panicum*)	168
Joint-grass (*Paspalum*)	21
Barngrass (*Chætochloa*)	271
Wild rice (*Zizania*)	24
Amaranth (*Amaranthus*)	4
Ragweed (*Ambrosia*)	189
Pigweed (*Chenopodium*)	4
Sunflower (*Helianthus*)	13
Gromwell (*Lithospermum*)	1
Plantain (*Plantago*)	1
Weeds—Continued.	Stomachs.
Smartweed (*Polygonum*)	200
Sorrel (*Rumex*)	64
Chickweed (*Alsine*)	9
Unidentified	168
Fruits:	
Blackberry (*Rubus*)	7
Blueberry (*Vaccinium*)	2
Gooseberry (*Ribes*)	1
Strawberry (*Fragaria*)	1
Indian currant (*Symphoricarpos*)	1
Hackberry (*Celtis occidentalis*)	1
Unidentified	14
Miscellaneous:	
Bayberry (*Myrica cerifera*)	2
Beechnuts (*Fagus*)	1
Pine seed (*Pinus*)	10
Sedge (*Carex*)	1
Bulb or tuber	4
Rubbish	54

In the list the chief interest, of course, centers about the grain. Of the four kinds eaten, oats are evidently the favorite, for they were found in 190 stomachs and amount to 6.3 percent of the year's food. April shows a little less than 6 percent for the month, undoubtedly collected from newly sown fields. In June they fall to less than 2 percent, in July rise to 22.6, increase somewhat in August, fall to 4.2 in September, and disappear entirely before the end of October. A few were found in December, but they do not appear in the other winter months. The oats eaten in July were probably taken from standing or newly cut grain, as perhaps were some of those eaten in August; but most of the oats in the United States are cut before the end of July, so that the greater part of those that were taken after this month must have been gleaned from the stubble or pilfered from the shock. Wheat first appears in March to the amount of 1.5 percent, but does not become an important item of food until July, when it rises abruptly to 13.1 percent. As July is the harvest month for wheat in most parts of this country it is reasonably certain that this grain is taken from the standing crop or gathered from the field after the reaper has done its work. August and September show 6.2 and 1.6 percent, respectively, all of which must have been scattered grain except where it could be stolen from the shock. The total amount of wheat for the year is only 2.2 percent. Corn is eaten to the extent of 2.6 percent in February, but the amount increases to 9.2 percent in March, after which it decreases to 3.0 percent in June. It rises through July and August to 7.5 percent in September, but falls off rapidly after September and is unimportant during the remainder of the year. The average for the year is 4.6 percent.

Grain collectively amounts to 13.9 percent of the food of the year, and its distribution as shown above leads to the conclusion that at least half of it is waste. Oats alone show an increased consumption in May, the month of sowing. July and August are the months of maximum consumption. All that is eaten after August, except corn, must be gathered from the stubble, unless the grain is left shocked in the field; and even in that case it is difficult to understand how the birds can do any serious damage if the shocks are properly put up and are not allowed to remain out an unreasonable time.

In order to gain a more thorough understanding of the grain-eating propensities of the redwings, a special study was made of the food for the five months from May to September, inclusive. Forty-six percent of the stomachs taken in May contained grain, and only 11 percent of those taken in June. The ratio then rises in July, and culminates at 72 percent in August, after which it decreases rapidly. The average for the five months is 46 percent; that is, in every 100 birds taken 46 had eaten grain. The grain-eating record, as exhibited by the bulk of the grain food, is quite different. Grain constitutes about 20 percent of the food by bulk in May and less than 6 percent in June, but rises to a maximum of nearly 43 percent in July and falls off slightly in August, after which it rapidly decreases and disappears. The average consumption for the five months is 24 percent of the whole food. Again, if the two months of July and August are considered alone, it will be found that although 68 of every 100 birds have eaten grain, this item constitutes only 41 percent of the food for the two months.

Still further restricting the study to birds taken in the Mississippi Valley, in the same five months, May to September, the percentage of grain shows an important increase. During these months 173 birds were collected in the States of Indiana, Illinois, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Nebraska, and Kansas. The number, though small, is sufficient to serve at least as a clue to the food during this period. Grain was eaten by 60 percent of the birds collected in May, by 46 percent of those taken in June, by 80 percent of those taken in July, by 81 percent of those taken in August, and by 45 percent of those taken in September. Of the food of those taken in May, 27 percent was grain of various kinds; in June, 23 percent; in July, 51 percent; in August, 45 percent, and in September 24 percent; an average of 34 percent of grain for the five months. As these are the ones in which nearly all of the grain is eaten, and as more than half of it is eaten in July and August, the above exhibit apparently shows the worst that the redwings do. Of the 1,083 stomachs examined, only 19 were filled with grain alone, while 217 were entirely filled with the seeds of weeds or useless plants. The total grain consumed, as given above, is less than that

eaten by the crow blackbird (45 percent), the jay (19 percent), or the cowbird (17 percent). In view of the fact that the redwing has been under the ban in many States and in some still remains so, this result is rather surprising. It renders more impressive the fact that the damage is due to overwhelming numbers in that part of the country from which the complaints have come, and not the amount of grain eaten by the individual bird. The unequaled facilities for breeding afforded by that region have in many instances given rise to such immense flocks in a restricted area that, while each bird eats but a trifle, the total is tremendous.

Weed seed is apparently the favorite food of the redwings, since the total amount of grass and weeds is 54.6 percent, more than half of the year's food, and more than four times the total grain consumption. These seeds are the principal article of diet of the birds in the Northern States in the early spring and late fall, and the stomachs received from the South during the winter are filled with them almost exclusively. They amount to more than 3 percent in June, the month of minimum consumption, and constitute a very appreciable percentage even during the months when grain is most abundant. The great bulk consists of the four well-known genera of noxious weeds, *Chætochloa* (barn-grass or foxtail), *Ambrosia* (ragweed), *Panicum* (panic-grass), and *Polygonum* (smartweed and knotweed). The others were found in from 1 to 64 stomachs each, and while not all are as much of a nuisance to clean cultivation as the four named, none have any useful function in agriculture. Fruit forms so insignificant a proportion of the redwing's food that it is hardly worth considering. Blackberries or raspberries were identified by their seeds in 7 stomachs, but only a few were found in each, and the percentage is trifling. The other species taken also appear in few stomachs and in small quantities.

The miscellaneous list contains a collection of makeshifts upon which the bird falls in case of necessity, the most curious of which, perhaps, is the seed of the pine tree. The birds from whose stomachs these were obtained were shot in the very act of picking the seeds from the cones in the top of the tree, a strange employment for an inhabitant of a marsh, but Dr. Coues notes the breeding of this bird near pine trees at a distance from any marsh.[1]

SUMMARY.

In summing up the economic status of the redwing the principal point to attract attention is the small percentage of grain in the year's food, seemingly so much at variance with the complaints of the bird's destructive habits. Judged by the contents of its stomach alone, the redwing is most decidedly a useful bird. The service rendered by the destruction of noxious insects and weed seeds far outweighs the

[1] Birds of the Northwest, p. 187, 1874.

damage due to its consumption of grain. The destruction that it sometimes causes must be attributed entirely to its too great abundance in some localities.

The following table shows the various elements of its food for each month:

Food of the red-winged blackbird.

[NUMBER OF STOMACHS EXAMINED: January, 11; February, 48; March, 84; April, 104; May, 75; June, 158; July, 141; August, 151; September, 56; October, 91; November, 82; December, 82; total, 1,083.]

Food.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average.
ANIMAL.	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*
Predaceous beetl's	.....	0.2	3.1	2.7	6.5	6.5	6.5	1.9	1.5	0.3	0.1	0.4	2.5
Snout-beetles	.....	1.3	0.8	6.4	7.2	22.4	7.8	2.5	0.2	0.4	[1]Tr.	0.7	4.1
Other beetles	0.1	2.2	1.2	7.8	11.2	13.4	3.9	1.8	0.1	0.8	[1]Tr.	0.2	3.5
Caterpillars	0.1	2.1	8.2	8.2	20.1	16.4	4.3	0.9	9.5	0.3	[1]Tr.	0.3	5.9
Grasshoppers	.....	0.2	0.2	4.6	3.3	12.7	13.4	17.0	4.1	1.1	[1]Tr.	[1]Tr.	4.7
Other insects	1.2	0.2	0.7	6.0	16.3	9.0	9.8	2.4	1.0	1.6	0.1	0.6	4.1
Spiders and myriapods	.....	0.3	0.5	3.2	2.0	5.8	2.0	0.4	[1]Tr.	0.2	0.1	1.4	1.3
Other animal food	.....	.....	0.7	1.5	1.4	2.0	0.2	0.1	0.1	.....	.....	.....	0.5
Total animal food	1.4	6.5	15.4	40.4	68.0	88.2	47.9	27.0	16.5	4.7	0.3	3.6	26.6
VEGETABLE.													
Fruit	.....	2.0	1.2	0.6	.....	0.5	2.1	0.6	.....	.....	[1]Tr.	.....	0.6
Corn	.....	2.6	9.2	7.8	5.1	3.0	4.2	5.7	7.5	6.9	1.4	1.3	4.6
Oats	.....	.....	.....	5.9	13.5	1.4	22.6	27.3	4.2	0.3	.....	0.2	6.3
Wheat	.....	.....	1.5	2.6	0.7	0.9	13.1	6.2	1.6	.....	0.1	.....	2.2
Other grain	.....	0.8	1.2	2.3	0.4	0.4	2.7	1.8	.....	.....	.....	.....	0.8
Weed seeds	98.6	85.3	70.3	35.7	10.2	3.6	4.5	15.5	55.7	88.0	97.0	91.2	54.6
Other vegetable food	.....	2.8	1.2	4.7	2.2	1.9	2.9	15.9	14.5	0.1	1.2	3.7	4.3
Total vegetable food	98.6	93.5	84.6	59.6	32.1	11.7	52.1	73.0	83.5	95.3	99.7	96.4	73.4

[1] Tr. = trace.

CALIFORNIA RED-WINGED BLACKBIRD.

(*Agelaius gubernator californicus.*)

The California red-winged blackbird is confined to the Pacific coast region west of the Cascades and the Sierra Nevada, and ranges from Washington to Lower California. The stomachs upon which this investigation is based, 61 in all, were collected in California at different times of the year, but none in February, May, or August (see p. 74). Although this number is entirely too small to give data that can be considered final, it is thought best to publish those obtained, as they will give some insight into the character of the food.

Of the total food, only 1.6 percent is animal matter, and the remainder, 98.4 percent, is mostly grain. The animal food consists of beetles, ants, grasshoppers, bugs, caterpillars, and a few spiders—mostly harmful, but so few in number that they are economically insignificant. Of the 98.4 percent of vegetable food, 85.5 percent consists of grain. This is made up of wheat, 28.9 percent; oats, 52.3 percent; and barley, 4.3 percent. Corn was not found. It is probable that this record would be somewhat modified by an examination of a larger series of stomachs representing every month of the year, but it must be remembered that one of the missing months is February, a month when birds feed to a great extent upon vegetable food, and another is August, which is a harvest month. The other vegetable food (12.9 percent) consists mostly of the seeds of noxious weeds.

Further field observation of the habits of this species is needed, but it is probable that the bird does great damage in places where it is abundant, especially in grain-growing sections. In view of the very large percentage of grain in the stomachs, and the fact that grain forms more than half the food in every month, it does not seem probable that the bird is able to supply its wants from the waste grain of the fields and corrals. Even if 50 percent were so obtained, a large percentage, more than 40 percent, of the total food still remains to the discredit of the species. Further investigation is necessary before final conclusions can be drawn, but it hardly seems probable that it can show the California redwing in any other light than that of a source of danger to grain.

THE RUSTY BLACKBIRD.

(*Scolecophagus carolinus.*)

One of the most familiar sights to the New England schoolboy, and one which assures him that spring is really at hand, is a tree full of blackbirds, all facing the same way and each one singing at the top of its voice. These are rusty blackbirds, or rusty grackles, which, on their spring journey to the north, have a way of beguiling the tedium of their long flight by stopping and giving free concerts. Every farmhouse by the wayside will have its visitors, and every boy who hears them is eager to tell his mates that he has seen the first flock of blackbirds. They breed in the Maritime Provinces of Canada, the northern parts of New England, New York, and Minnesota and northwestward nearly to the mouth of the Mackenzie River and Kotzebue Sound, Alaska; and spend the winter in the Southern States as far west as Texas and as far north as southern Illinois. In their migrations they are seen in immense numbers, especially in the Mississippi Valley.

The great majority of these birds nest so far north that they are beyond the limits of cultivation, and consequently have no economic interest during the breeding months. But as soon as the season of reproduction is over they begin to assemble and move southward, and it is evident that such vast flocks as they form might prove a serious menace to any crop on which they chose to prey. Reports, however, have not implicated them to any great degree in the devastation of grainfields, and it seems to be their habit to feed about swamps and in roads and stock yards. That they have a decided taste for foraging in wet ground or about water is shown by the contents of their stomachs, which included aquatic beetles of many species, with larvæ of ephemeridæ, caddice-fly cases, a few dragon-flies, small snails and other mollusks, salamanders, and small fishes.

The food of rusty blackbirds does not seem to have received much attention, but a few ornithologists have given it brief consideration.

Mr. C. J. Maynard reports that he has never found anything in their stomachs except insects and small mollusks.[1]

Col. N. S. Goss says:

> They are largely omnivorous in their food habits, preferring the various forms of insect life, snails, etc., that abound in the aquatic grasses; but during the winter months, when forced to feed largely upon grains and seeds, they frequent the cattle yards and corn fields, and further south forage off the rice plantations.[2]

Dr. Warren says:

> The food of this species consists largely of beetles, grasshoppers, snails and earthworms. They feed to a considerable extent on the seeds of various plants; different kinds of small berries are added to their *menu;* the scattered grains of wheat, rye or other cereals, which are to be found in the fields and meadows, are likewise eaten. When in cornfields they sometimes perch on the shocks and pick from the ears a few grains, the damage, however, which they do in this way is of but little importance.[3]

The investigation of the food of the rusty blackbird made by the Biological Survey is based on 132 stomachs, obtained from 16 States, the District of Columbia, and Canada (see p. 74). These stomachs represent every month of the year except June and July, when the birds are on their breeding range away from well-settled portions of the country. It is to be regretted that none of the months except March, April, October, and November are fairly represented. Few stomachs were obtained in the other months, January having but one to its credit.

The stomachs contained a larger proportion of animal matter (53 percent) than those of any other species of American blackbirds except the bobolink. This is the more remarkable in view of the fact that none were taken in the two breeding months of June and July, when in all probability the food consists almost exclusively of animal matter.

[1] Birds Eastern N. A., p. 147, 1881.
[2] Hist. Birds of Kansas, p. 408, 1891.
[3] Birds of Pa., revised ed., p. 219, 1890.

While the birds are decidedly terrestrial in their feeding habits, they do not eat many predaceous ground-beetles (Carabidæ), the total consumption of these insects amounting to only 1.7 percent of the whole food. Scarabæids, the May-beetle family, form 2 percent, and in April 11.7 percent. Various other families of beetles aggregate 10.1 percent, largely aquatic beetles and their larvæ, which, so far as known, do not have any great economic importance. A few of the destructive snout-beetles (Rhynchophora) are also included, as well as some chrysomelids and others.

Caterpillars constitute 2.5 percent and do not form any very striking percentage at any time, except, perhaps, in May, when they amount to 11.7 percent. Grasshoppers nearly equal beetles in the extent to which they are eaten, and exceed every other order of insects, although none appeared in the stomachs taken in January, March, May, and December, and in February but a trace. In August, as usual, they reach the maximum, 44.3 percent, only a trifle higher, however, than the October record. The average for the year is 12 percent. Various orders of insects, such as ants, a few bugs, and also a few flies, with such aquatic species as dragon-flies, caddice-flies, and ephemerids were eaten in all the months except January, in which only one stomach was taken. They aggregate 13.7 percent of the whole food, but owing to the number of forms no one amounts to a noteworthy percentage, and many of them are of little economic importance. Spiders and myriapods (thousand-legs) are eaten to the extent of 4 percent and amount to 23 percent in August. Other small animals, such as crustaceans, snails, salamanders, and small fish, were found in the stomachs for nearly every month, and amount to 7 percent of the food of the year, but none of them are important from an economic point of view.

The vegetable food consists of grain, weed seed, and various miscellaneous substances, none of which amounts to any great percentage. The latter consist chiefly of a very small amount of fruit, a little mast, and a number of unidentifiable substances, probably picked up about water or in swamps. Of grain, corn is the favorite and amounts to 17.6 percent of the year's food. It constitutes 87 percent of the contents of the single stomach taken in January, but this record can not be used as a criterion, for with this exception the maximum percentage is 26.5 (average of 15 stomachs taken in November), while the stomachs collected in May, August, and September show not a trace of corn. The fact that corn constitutes respectively only 5 and 4 percent of the contents of the stomachs taken in December and February is additional evidence that the January percentage is exceptional. Wheat and oats collectively amount to only 6.8 percent of the year's food. Oats are apparently preferred and in March constitute 15.4 percent of the month's food. These March stomachs came from the Southern States, so it is probable that the grain was picked up on newly sown fields. Neither wheat nor oats were found in the stomachs taken in August. Grain collectively amounts to 24.4 percent of the

whole food, but from its distribution through the year does not appear to have been taken from the harvest fields. It is probable that some of it was gathered from newly sown fields, but the greater part was undoubtedly stolen from cornerib or picked up in roads and stock yards as waste grain.

Weed seed is not so important an item of food with the rusty blackbirds as it is with the redwings, since with the former it amounts to only 6 percent of the year's food, and contrary to observations on most seed-eating birds, the greater portion of it is apparently eater in the insect season. Only 1 percent was found in the stomach taken in January, but the amount increases irregularly up to a maximum of 23.3 percent in May. Of June and July we know nothing, but in August, the month in which the redwing begins to increase its seed diet, there is not a single trace of weed seed in the food of the rusty blackbirds. It constitutes 6.6 percent in September, a trifle in October, and 15 percent in November and is entirely absent in the 3 stomachs taken in December. This erratic distribution evidently indicates that weed seed is not sought after, but is simply taken when nothing better is at hand. Miscellaneous items of vegetable food amount to 16.6 percent of the food of the year. Fruit was found in a few stomachs, but does not appear to any important extent. Only three kinds were determined, but several stomachs contained pulp or skin that could not be identified. Several buffalo berries (*Shepherdia argentea*) were found in one stomach, hackberries (*Celtis occidentalis*) in another, and seeds of blackberries or raspberries (*Rubus*) in two or three others. Mast was found in a few stomachs, but the greater part of the miscellaneous food was indeterminable. The birds are evidently great scavengers, and so gather much food that is scarcely susceptible of classification.

SUMMARY.

While this record of the food of the rusty blackbird is somewhat fragmentary it still gives a very good idea of the bird's general diet. One important conclusion that can be drawn is that animal food is preferred, vegetable food serving as a makeshift. It is nearly certain that in June and July, when the birds are engaged in the exhausting function of reproduction, the diet must be almost exclusively animal. If those months were represented in this investigation, the relative proportion of the two classes of food would be much changed, and animal food would take a higher rank. The vegetable food is of little consequence, as the birds show no decided predilection for any particular kind, but eat whatever is at hand when animal food can not be obtained. Grain is not eaten to any great extent at harvest time, and the other items do not seem to have any special relation to the season in which they are eaten. While considerable animal food beside insects is eaten, on the other hand a considerable quantity of harmful

insects is destroyed and very few useful ones are taken. As rusty blackbirds do not inhabit farms, their economic relations can not be said to be very important; but while not preying directly upon noxious insects or weeds which interfere with the cultivation of crops, it is yet possible that they incidentally do considerable good by eating insects. Although their foraging is done mostly in pastures and swamps, yet the insects which they devour count just so much from the sum total, and in the long run the destruction of noxious species is, perhaps, nearly as great a good to the farmer as though they were taken directly from his cultivated fields.

Grasshoppers and many scarabæid beetles are nuisances, and their destruction is a benefit to agriculture, no matter where they may be found. The same may be said of caterpillars and many other insects, which, though now feeding on useless plants of the marsh or thicket, are liable at any time, through an unusual increase in numbers or a change in environment, to turn their attention to some crop and become a veritable pest. On the other hand, aquatic beetles and small crustaceans, which form a considerable percentage of the diet of the rusty grackles, are to a great extent carnivorous in their habits, and it is difficult to see in what way they can ever become of any great economic importance.

The following table shows the percentages of the principal elements of the food for each month:

Food of the rusty blackbird.

[NUMBER OF STOMACHS EXAMINED: January, 1; February, 6; March, 17; April, 49; May, 7; June, none collected; July, none collected; August, 4; September, 5; October, 25; November, 15; December, 3; total, 132.]

Food.	January.	February.	March.	April.	May.	August.	September.	October.	November.	December.	Average.
ANIMAL.	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*
Predaceous beetles	.....	.....	4.5	6.1	.....	1.8	1.6	2.2	0.3	.....	1.7
May-beetle family	.....	2.5	.....	11.7	.....	0.7	.....	3.2	2.2	.....	2.0
Other beetles	.....	37.3	13.4	13.7	25.9	1.0	7.0	1.6	1.3	.....	10.1
Caterpillars	.....	4.0	1.5	5.0	11.7	.....	.....	2.3	0.4	.....	2.5
Grassboppers	.....	0.2	.....	9.3	.....	44.3	18.6	44.2	3.9	.....	12.0
Other insects	.....	25.8	13.9	15.5	20.0	26.0	16,0	4.5	13.2	1.7	13.7
Spiders and myriapods	.....	0.9	3.8	4.9	4.1	23.0	.....	2.7	0.3	.....	4.0
Other animal food	.....	1.5	7.7	2.5	1.3	.....	16.2	5.1	5.9	30.0	7.0
Total animal food	.....	72.2	44.8	68.7	63.0	96.8	59.4	65.8	27.5	31.7	53.0
VEGETABLE.											
Corn	87.0	4.0	23.8	20.8	.....	.....	.....	9.0	26.5	5.0	17.6
Other grain	12.0	.....	15.4	3.7	12.1	.....	13.4	7.3	4.5	.....	6.8
Weed seed	1.0	0.3	8.4	4.4	23.3	.....	6.6	0.8	15.0	.....	6.0
Other vegetable food	.....	23.5	7.6	2.4	1.6	3.2	20.6	17.1	26.5	63.3	16.6
Total vegetable food	100.0	27.8	55.2	31.3	37.0	3.2	40.6	34.2	72.5	68.3	47.0

BREWER'S BLACKBIRD.

(*Scolecophagus cyanocephalus.*)

Brewer's blackbird breeds from Manitoba and the eastern edge of the Great Plains south to northern New Mexico and westward to the Pacific, and spends the winter in the southern part of this region and in Mexico. The economic status of the species has as yet hardly become well defined, but some complaints have been received from the grain-growing sections, and it may possibly be a pest where it exists in any great numbers. The bird is eminently gregarious most of the year, though less so at breeding time. Like the cowbird, it is an industrious gleaner in pastures, barnyards, and roads, and even invades the streets of towns for the purpose of gathering scattered grain and other forage.

But little testimony is available as to the food of Brewer's blackbird, but Goss says that the members of this species are "social, gregarious birds, breeding in small colonies, and foraging together over the cultivated fields, pastures and plains; indiscriminate eaters of insect life, seeds, etc., and * * * regular visitants of the slaughterhouses."[1] In the investigation by the Biological Survey 146 stomachs were examined, collected from six States and representing every month except April (see p. 75).[2] The first analysis of the food shows that animal matter forms 31.8 percent and vegetable matter 68.2 percent. The animal food consists almost wholly of insects, the only exceptions being a few spiders and snails. The insects are mostly beetles, ants, wasps, and grasshoppers, with a few caterpillars, flies, and bugs. Beetles amount to 7.8 percent of the food of the year. The only group which appears at all prominently is that of the snout-beetles, or Rhynchophora, which in May constitute 29 percent of the food. In the other months they are not found so often, and the average for the year is only 3.4 percent. Predaceous beetles (Carabidæ) are eaten to the amount of 1.7 percent, and are not conspicuous in any month. Hymenoptera constitute 14.8 percent of the food for August, but do not appear very prominently in the other months, and average but 2.5 percent for the year. They consist for the most part of wasps and ants, with a few of the smaller parasitic species.

Grasshoppers are the favorite insect diet, constituting more than half of the total animal food (16.1 percent). Only a trace appears in the February stomachs, but in March the amount increases to 20.5 percent, and except in July does not fall below this figure until October. In August, which as usual is the month of greatest consumption, grasshoppers constitute 47.5 percent—nearly half of all the food.

[1] Hist. Birds of Kansas, p. 409, 1891.

[2] One stomach was taken in April, but as its contents were quite unlike the average of those collected in March and May, it has been disearded until more can be obtained for the same month.

In July the percentage falls to 8.2, apparently because at that time the grain harvest is at hand and the birds eat freely of oats, wheat, etc. The miscellaneous list is made up of a few flies, bugs, and caterpillars, the latter such as might be expected in the stomach of a bird of the habits of the species under consideration, though the number really found is surprisingly small. One stomach taken in California in March contained 90 per cent of caterpillars, and a few other stomachs contained them in smaller amounts; but they do not constitute an important percentage of any month. Mr. J. F. Illingsworth, of Ontario, Cal., says that he has never failed to find from one to five worms [caterpillers] in each stomach that he has examined, which indicates that under some circumstances they do eat these insects extensively.

The vegetable food of Brewer's blackbird is preeminently grain, which amounts to 60.3 percent of the total food of the year, while all other vegetable food aggregates only 7.9 percent. Oats, corn, wheat, and a little barley are eaten, and of these oats are the most important, amounting to nearly three-fourths of the total quantity and being eaten in every month of the year.[1] Corn stands next to oats, but far below in quantity; wheat follows next in order, and barley comes last, the latter having been found in only two stomachs.

So important an element is grain that it constitutes more than 50 percent of the food in each of eight months, and in May, the month of least consumption, still amounts to 21 percent of the whole food. While much of this may be waste grain, it can hardly be probable that all of it is picked up in highways and byways. In July it amounts to nearly 72 percent of the food, and there can be no doubt that much of this is gathered from ripening fields. Other vegetable food consists for the most part of weed seed, but the small amount differs remarkably from the quantities eaten by the redwing and cowbird, which are great weed destroyers at all times, and especially in winter. Brewer's blackbird eats grain in every month, and in winter subsists upon it almost entirely. Mr. Walter K. Fisher, writing from Stockton, Cal., reports it as feeding on newly sown wheat that had not been harrowed in and eating nearly all that had been thus left exposed. He describes the birds as visiting the fields in immense flocks, which, at a distance, look like smoke rising from the ground, and says that stomachs of birds taken on such fields were found to be full of wheat.

SUMMARY.

In summing up the results of this investigation it must be acknowledged that the stomachs examined are too few, and are not distributed widely enough geographically, to justify a final economic classification of the bird. Nevertheless some very salient points seem to have been

[1] The greatest quantities were found in stomachs taken in January at Escondido, Cal.

brought out, viz: (1) No order of insects is especially sought except grasshoppers (Orthoptera), which constitute more than half of the animal food; (2) more than 88 percent of the vegetable food consists of grain, which is eaten freely at all seasons, even when insects are abundant; and (3) seeds of harmful weeds are eaten sparingly.

In spite of this apparently discreditable record complaints of this blackbird have been fewer than of several other species, while, on the other hand, some observers speak highly of it. Prof. A. J. Cook, of Claremont, Cal., says that he considers it one of the most valuable species in that State. So far as shown by field observation and stomach examination it does not attack fruit, and this is an important point in a California bird. Mr. J. F. Illingsworth, of Ontario, Cal., in a paper read before the Pomona Farmers' Club,[1] speaks of the species as a beneficial one that should be protected. It is possible that the large amount of grain found in the stomachs consists principally of gleanings from the harvested fields, corrals, and other places; but even if this be true, a bird with such a pronounced taste for grain would, if abundant, always be a menace to ripening crops. The following tabular statement shows the principal elements of the food:

Food of Brewer's blackbird.

[NUMBER OF STOMACHS EXAMINED: January, 7; February, 7; March, 4; April, no stomachs collected, May, 7; June, 10; July, 10; August, 24, September, 38; October, 14; November, 10; December, 15. Total, 146.]

Food.	January.	February.	March.	May.	June.	July.	August	September.	October.	November.	December.	Average.
ANIMAL.	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*	*Per-cent.*
Predaceous beetles	5.0	0.6	.....	0.3	3.3	.....	3.9	0.9	.....	3.7	1.1	1.7
Snout-beetles	.....	0.4	2.0	29.0	4.5	0.5	[1]Tr.	0.3	.....	0.2	0.9	3.4
Other beetles	3.4	3.0	0.3	3.0	13.7	3.8	0.6	0.3	0.4	0.9	0.3	2.7
Wasps, ants, etc	.....	0.1	0.5	0.8	3.2	0.4	14.8	0.6	7.2	.....	0.1	2.5
Grasshoppers	.....	0.2	20.5	33.3	26.8	8.2	47.5	33.1	0.6	.....	7.1	16.1
Other insects	1.0	4.0	22.5	9.0	10.6	.....	0.6	1.1	0.8	8.4	0.9	5.4
Total animal food	9.4	8.3	45.8	75.1	62.1	12.9	67.4	36.3	9.0	13.2	10.4	31.8
VEGETABLE.												
Grain	90.6	77.1	53.2	21.0	32.7	71.9	29.8	48.1	85.4	71.8	81.7	60.3
Other vegetable food	.....	14.6	1.0	3.6	5.2	15.2	2.8	15.6	5.6	15.0	7.9	7.9
Total vegetable food	90.6	91.7	54.2	24.6	37.9	87.1	32.6	63.7	91.0	86.8	89.6	68.2

[1]Tr. = trace.

[1] Ontario Observer, June 3, 1899.

THE CROW BLACKBIRD.[1]

(*Quiscalus quiscula.*)

Throughout the Eastern States and Mississippi Valley the grackle, or crow blackbird, is one of the most familiar and conspicuous birds. It appears in spring and early summer about farmhouses and villages, where it finds its favorite nesting places. Five different kinds occur within our borders, but the present paper is concerned only with the common purple grackle (*Quiscalus quiscula*) and its two subspecies, the bronzed grackle (*Quiscalus q. æneus*) and the Florida grackle (*Quiscalus q. aglæus*). The purple grackle is abundant in the region east of the Alleghenies as far north as New York, and is found sparingly in New

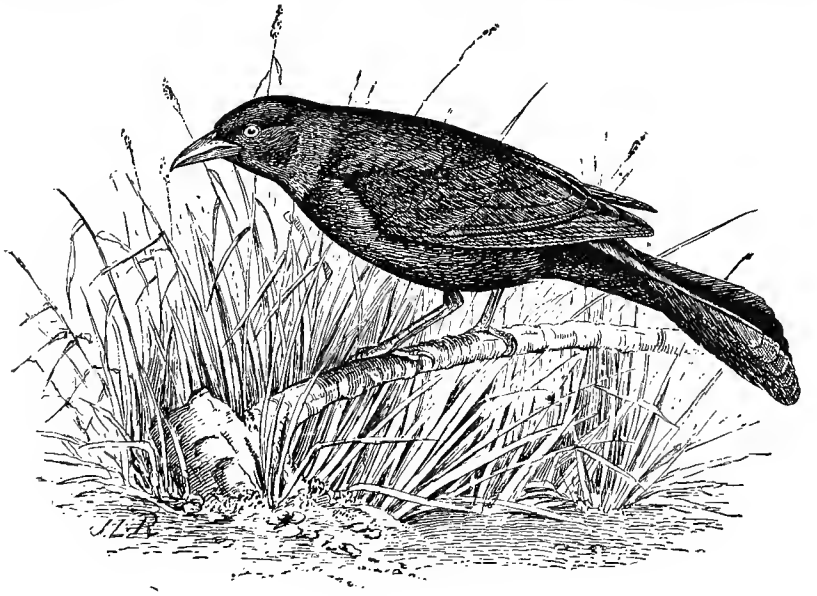


FIG. 6.—Crow Blackbird.

England. The Florida grackle is distributed over the region extending from the coast of South Carolina southward into the peninsula of Florida and westward to Louisiana. The bronzed grackle occupies the Mississippi Valley and Great Plains as far west as the Rocky Mountains, ranges northward to Great Slave Lake and southern Newfoundland, and east to the coast of southern New England.

In Canada and the Northern United States the crow blackbird is only a summer resident, but in the Southern States it is present throughout the year, and in winter its numbers are increased by millions of migrants from the North, which find here a congenial winter

[1] Revised and republished from the Yearbook of the Department of Agriculture for 1894, pp. 233–248, with the addition of new material.

home. It does not occur south of the Gulf States, but stragglers have been found during the cold months as far north as Illinois and even Minnesota.

At the first approach of spring the crow blackbirds begin to move northward, closely following the retreat of winter. During the summer months they cover the whole of the United States east of the Rocky Mountains, except New England, though they are most plentifully distributed over the great grain-raising States of the Northwest. In New England crow blackbirds are of local occurrence. They are tolerably abundant in Connecticut, but in the more northern States breed only in certain favored localities, and are entirely absent from large areas.

In the Northern United States the southward movement begins about the end of September, although the habit of collecting in flocks immediately after the breeding season causes the birds to disappear from many localities during the month of August. Their stay in the northern part of the country is thus limited to the six warmest months of the year; hence whatever they do that is either beneficial or injurious must be accomplished during that time. In the South, on the contrary, they are found throughout the year, and in largely increased numbers during the winter. Fortunately, however, the time of their greatest abundance is not the season of growing crops, so that the damage done is principally confined to the pilfering of grain left standing in the shock. It is probable, however, that at this season they feed largely on weed seeds, mast, and waste grain scattered in the field.

Crow blackbirds are gregarious, usually breeding in colonies and migrating in flocks. In fall, young and old collect in large assemblages, which in the Mississippi Valley often grow to enormous size. The redwing (*Agelaius phœniceus*), Brewer's blackbird (*Scolecophagus cyanocephalus*), and the rusty blackbird (*S. carolinus*) often associate with them. Moving southward, immense flocks cross the Red River Valley between Texas and Indian Territory. In September, 1886, Mr. George H. Ragsdale reported at Gainesville, on the Texas side of the river, "flocks of such size that the roar of their wings could be heard for a quarter of a mile," and that, according to a statement published in a local paper, one person had on hand 8,000 blackbirds which had been netted for the use of gun clubs. Mr. Ragsdale stated that at the same time the grass worm was destroying the crab-grass and purslane, and attributed the unusually large flocks of blackbirds to the fact that the early fall migrants, finding so many worms, had halted until the bulk of the birds drifted southward. About the first of October the worms and birds disappeared simultaneously.

Crow blackbirds are well known to the farmer as foragers about the barnyard and pigpen. When they arrive in spring, after their long journey from the South, they are apt to depend on the cornerib for

some of their first meals; but when the plow begins its work they are on the alert, and follow it up and down the furrows, seizing every grub or other insect that may be turned up. Their industry in this respect is very noticeable, and if not disturbed or frightened in any way they often become so tame as scarcely to get out of the way of the team in their eager search for food. Very soon a nest is built, and in a short time four or more gaping mouths demand to be filled, and the parent birds must then work harder and go farther afield to provide for the increased number of stomachs. When the cherries and other early fruits ripen, the birds take a share for themselves thinking, no doubt, that they are fairly entitled to them for the good work they did earlier in the season. When the corn 'comes into the milk' they also take a portion.

In the selection of food the crow blackbird is almost omnivorous. Its partiality for corn, wheat, rice, oats, and other grain is well known, and is the cause of nearly all the complaints about its depredations. This diet is supplemented by various fruits, berries, nuts, seeds, and insects, the last in large proportion. But the character of the food varies materially with the season. During the fall and winter blackbirds subsist largely on seeds and grain, as spring approaches they become more insectivorous, in summer they take small fruits, and in September they attack the ripening corn; but at all seasons they probably select the food that is most easily obtained.

To this varied diet are due the conflicting statements respecting the useful or noxious habits of the species. When feeding on grain, the birds are usually in large flocks and their depredations are plainly visible. When breeding they are less gregarious, and the good work they do in the fields is scarcely noticed, although at this season the grubs and other insects devoured compensate in large measure for the grain taken at other times. As Mr. N. W. Wright, of Farmland, Ind., aptly says, "It is hard to tell on which side to place the crow blackbirds, for we can see the damage done, but not the benefits."

During the spring they destroy many noxious insects. Prof. D. E. Lantz states that at Manhattan, Kans., from the time of their arrival until August they feed almost entirely upon cutworms, and Prof. Herbert Osborne, writing from Ames, Iowa, reports that during the spring of 1883 he saw them destroy great numbers of May-beetles (*Lachnosterna fusca*), and found them feeding on them for several weeks. Grasshoppers, crickets, locusts, and other insects are also largely eaten. Mr. J. Percy Moore, of Philadelphia, Pa., wrote in 1885:

> During the recent visit of the 17-year cicada this species [the purple grackle] devoured immense numbers of pupæ and imagos. It also ate large numbers of the grubs of the June bug, which it generally obtained by searching in the furrows in newly plowed fields, and all stages of the Carolina and other grasshoppers, the common white butterfly (I saw one catch several of this species on the wing May 26, 1885), and other species not identified.

Mr. W. B. Hall, of Wakeham, Ohio, gives an interesting account of some young grackles which were kept in captivity. He says:

> I have captured the young and confined them in a cage in such manner that the old bird could not reach the mouth of the young. The food brought consisted largely of larvæ of *Coleopterous* and *Lepidopterous* insects, with an occasional beetle. If freshly plowed fields were in the vicinity the food consisted largely of the white grub and cutworm, a few tent caterpillars, one worm that I took to be a small *Attacus*, and beetles of the genera *Galerita*, *Cetonia*, *Lachnosterna*, and their kindred.

An estimate of the amount of food required to support a large flock of blackbirds has been made by Mr. H. H. Johnstin, of London, Ohio. During the autumn of 1894 he counted 1,100 blackbirds one morning as they left their roosting places for the feeding grounds, and estimated the birds which flew by at 50,000. Allowing 2 ounces as the quantity of food collected by each bird during the day, he arrived at the conclusion that 6,250 pounds, or more than 3 tons, of food was consumed by this army of blackbirds in a single day. Even if the number of birds in this case is not overestimated, the amount of food per bird is undoubtedly too great. The species of blackbirds to which these notes refer are not stated, but it is safe to assume that the flocks were made up of redwings (*Agelaius*) and crow blackbirds (*Quiscalus*). A full stomach of the crow blackbird, selected at random from specimens in the collection of the Biological Survey, was found to weigh 0.158 ounce, or 2.53 drams, while the contents of another stomach weighed only 0.116 ounce, or 1.85 drams. The average of two full stomachs of red-winged blackbirds was 0.049 ounce, or 0.78 dram, and the stomach contents of a third weighed only 0.021 ounce, or 0.33 dram. While of course these figures do not give the quantity of food a bird consumes in twenty-four hours, they show that the full stomach of a blackbird weighs comparatively little. In order to consume 1 ounce of food per day a crow blackbird must eat six or eight full meals, according to the kind of food, and the redwing three or four times as many. At this rate the amount consumed by the flock of 50,000 birds would be about a ton and a half per day. These figures are undoubtedly still too large, but they serve to give a slight hint of the quantity of grain a large flock could destroy.

The accusations against the crow blackbird, briefly stated, relate mainly to the destruction of grain, especially corn, soon after planting in the spring, and again in the autumn, when the corn is 'in the milk' and nearly ripe. In the Southern States rice is also destroyed by grackles. In some sections they are said to feed upon young grain in such quantities as seriously to injure the value of the crop, and for this reason they are poisoned in large numbers. A more effectual method is to prevent the birds from taking the seed by tarring the corn before it is planted. This is better, simpler, and cheaper than the wholesale destruction of the birds.

Mr. S. T. Kimball, of Ellington, Conn., says:

As a rule, farmers here tar their corn, but last June I sowed some without tarring, and the result was that by the time it was out of the ground the blackbirds had attacked it. They worked all day, carrying their bills full—load after load—to a cemetery where there is quite a colony. They kept this up till the corn was entirely absorbed by the stalk, although I shot some five or six of them.

Mr. George K. Cherrie states that in Monona County, Iowa, during the spring of 1884, both the crow blackbird and the yellow-headed blackbird did considerable damage by pulling the corn just as it came through the ground, and were poisoned in great numbers by corn which had been soaked in water containing arsenic. Similar depredations are sometimes committed in the rice fields of the South.

According to Mr. W. C. Percy, jr., of Bayou Goula, La., the crow blackbirds destroy rice and corn at that place to a great extent, and would do so totally were not men stationed with guns. They eat it in planting time only.

In the autumn, when the corn begins to ripen, the fields are again visited by blackbirds in larger flocks than in the spring, and the birds renew their work of destruction. Mr. Daniel S. Wardsworth reports that in a field of 2 acres near Hartford, Conn., the grackle has been known to ruin from one-third to one-half of a crop of corn 'in the milk' or when ripe. A similar complaint was made by Mr. George H. Selover, of Lake City, Minn.

Mr. S. Powers, of Lawtey, Fla., writes that in the section where he lives corn is left on the stalk as long as possible, to escape the weevils, and the blackbirds eat the ends of many ears, sometimes one-third of their length.

Another accusation often made against the crow blackbird is that it destroys the eggs and young of other birds. A cursory examination of the statements of writers shows that very few are based on original observation; the majority are either repeated from the observations of others or are taken from published accounts of the bird's habits. It can not be doubted, from the statements which have been made, that these birds do occasionally destroy the eggs of the robin, bluebird, chipping sparrow, small flycatchers, and other species, and more rarely the young of the robin. But stomach examination offers little corroborative evidence. Of 2,346 stomachs, only 37 contained any trace of birds' eggs, and 1 contained the bones of a young bird. These were distributed as follows: In April, 9; May, 9; June, 7; July, 7; and August, 5. The greatest quantity of eggshell was found in May, aggregating forty-six one-hundredths of one percent of the stomach contents for that month. This certainly does not show that blackbirds are much given to robbing their neighbors. Further, the eggshells found in a number of stomachs were identified as those of domesticated fowls, and were probably obtained from compost heaps,

where they had been thrown. Hence, it seems fair to infer that the grackle indulges its nest-robbing proclivities only occasionally, and that the prevalence of the habit has been considerably exaggerated.

The crow blackbird, by reason of its habits, numbers, and wide distribution over the eastern part of our country, is so conspicuous among the native birds that much valuable information concerning its food habits is contained in previous publications.

Wilson refers to it as a 'noted depredator' that 'is well known to every careful farmer of the Northern and Middle States,' and says:

> About the 20th of March the purple grakles visit Pennsylvania from the south, fly in loose flocks, frequent swamps and meadows, and follow in the furrows after the plough; their food at this season consisting of worms, grubs, and caterpillars, of which they destroy prodigious numbers, as if to recompense the husbandman beforehand for the havoc they intend to make among his crops of Indian corn. * * * The trees where these birds build are often at no great distance from the farm house, and overlook the plantations. From thence they issue, in all directions, and with as much confidence, to make their daily depredations among the surrounding fields, as if the whole were intended for their use alone. Their chief attention, however, is directed to the Indian corn in all its progressive stages. As soon as the infant blade of this grain begins to make its appearance above ground, the grakles hail the welcome signal with screams of peculiar satisfaction, and, without waiting for a formal invitation from the proprietor, descend on the fields and begin to pull up and regale themselves on the seed, scattering the green blades around. * * * About the beginning of August, when the young ears are in their milky state, they are attacked with redoubled eagerness by the grakles and redwings, in formidable and combined bodies. They descend like a blackening, sweeping tempest on the corn, dig off the external covering of twelve or fifteen coats of leaves, as dexterously as if done by the hand of man, and, having laid bare the ear, leave little behind to the farmer but the cobs, and shriveled skins, that contained their favorite fare. I have seen fields of corn of many acres, where more than one-half was thus ruined. Indeed the farmers in the immediate vicinity of the rivers Delaware and Schuylkill, generally allow one-fourth of this crop to the blackbirds, among whom our grakle comes in for his full share.
>
> * * * As some consolation, however, to the industrious cultivator, I can assure him, that were I placed in his situation, I should hesitate whether to consider these birds most as friends or enemies, as they are particularly destructive to almost all the noxious worms, grubs, and caterpillars, that infest his fields, which, were they allowed to multiply unmolested, would soon consume nine-tenths of all the production of his labour, and desolate the country with the miseries of famine.[1]

Nuttall speaks of the bird's destructiveness in the cornfield in much the same terms, and adds:

> Up to the time of harvest, I have uniformly, on dissection, found their food to consist of these larvæ, caterpillars, moths, and beetles, of which they devour such numbers, that but for this providential economy, the whole crop of grain, in many places, would probably be destroyed by the time it began to germinate. In winter they collect the mast of the beech and oak for food, and may be seen assembled in large bodies in the woods for this purpose.[2]

[1] Am. Ornith., Edinburgh ed., Vol. I, pp. 227–230, 1831.
[2] Manual of Ornith., Land Birds, pp. 195–196, 1832.

Mr. C. J. Maynard repeats the charges of depredations in the cornfield, but contends that their trait of robbing nests of other birds is by far the worst damage they do. He says:

They will visit the homes of those species which build in accessible situations and deliberately remove the eggs or, what is more to be deplored, the helpless young and devour them in spite of the cries of the distracted parents who are powerless to prevent the outrage. * * * So frequently were these depredations committed upon the homes of the Robins and other birds, that built about my place this season, that there was scarcely an hour in the day during early summer when I could not hear the warning cries of the adult birds, followed by the harsh, scolding notes of the Crow Blackbird as he was vigorously attacked on all sides, but he seldom retreated without accomplishing his purpose. Such continuous slaughter must greatly thin the ranks of the birds that are thus robbed and it will be safe to say that the Purple Grackles destroy more birds than all the other predatory species combined. * * *

In Florida * * * they also eat a variety of food. In early Winter large flocks may be seen on the tops of the palmettos, feeding on the fruit, and they also eat berries in their season. Later small flocks are found on the margin of streams, frequently wading into them in search of little mollusks, crabs, etc., and it is not rare to meet with one or two scattering individuals in the thick hummocks, overturning the leaves in order to find insects or small reptiles which they devour. I once saw one catch a lizard which was crawling over the fan-like frond of a palmetto, and fly with it to the ground. The reptile squirmed all the while in its frantic endeavors to escape, but the Blackbird held it firmly and, after beating it to death, removed the skin as adroitly as if accustomed to the operation, then swallowed the body.[1]

Dr. B. H. Warren says as a result of his investigations of the food of the crow blackbird:

In the wake of the plowman, as he turns the crumbling earth, closely follow the argus-eyed Grackles, ever on the alert to seize the wriggling worm, the agile beetle, or the glistening grub, and the numerous *larvæ* thrown out as each furrow is turned. Certainly, at this season our sable acquaintances are engaged only in that which will prove of utility to the cultivator when his crops are growing. We repeatedly hear of how the blackbirds tear up and devour the young and growing corn. This, unquestionably, is sometimes the case, but I am confident that the destruction thus done is much exaggerated. I am aware that on more than one occasion I have seen the tender blades of corn lying on the ground where were actively at work Crow Blackbirds, a number of which were shot, and on a post-mortem dissection their stomachs revealed almost entirely insects. Some six years ago I was visiting a friend who had thirty-odd acres of corn (maize) planted. Quite a number of "blackies," as he styled them, were plying themselves with great activity about the growing cereal. We shot thirty-one of these birds feeding in the corn field. Of this number nineteen showed only *cut-worms* in their stomachs. The number of cut-worms in each, of course, varied, but as many as twenty-two were taken from one stomach. In seven some corn was found, in connection with a very large excess of insects, to wit: Beetles, earth-worms, and cut-worms. The remaining five showed chiefly beetles. * * *

Strawberries, blackberries and other fruits are fed upon, but to a very limited extent, by this species. The diet of the young birds, while under parental care, is almost exclusively insectivorous, consisting mainly of caterpillars and grubs.

It is a well-established fact that they are given to pillaging the eggs of other birds, especially the common Robin. Gentry, however, states that they destroy the young of birds, a fact, as yet, unobserved by the writer.[2]

[1] Birds of Eastern N. A., pp. 149–150, 1881.

[2] Birds of Pa., revised ed., pp. 221–222, 1890.

Nearly 2,500 crow blackbird stomachs have been examined in the laboratory of the Biological Survey, of which 2,346 contained food; the remainder were empty. These stomachs were obtained from twenty-seven States, the District of Columbia, and Canada (see p. 75). Nebraska and Dakota are the most western States in which any were collected, and Florida and Texas the most southern. The stomachs were taken during every month in the year, but as the great body of the birds leaves the Northern States in October and does not return until March, but few stomachs could be procured in November, December, January, and February. Great pains were taken to secure a large number during the breeding months of May and June, with the result that a little more than half of the whole collection was obtained at this time. Observation has shown that the food of young birds often differs materially from that of the adults, and in order to test this point 456 nestlings were collected in May and June.

The food of the whole year, taking into account all the 2,346 stomachs, young and adult, comprised 30.3 percent animal, and 69.7 percent vegetable matter. The animal food was found to be composed of insects, spiders, myriapods, crayfish, earthworms, sowbugs, hair snakes, snails, fish, tree toads, salamanders (newts), lizards, snakes, birds' eggs, and mice.

Insect food constitutes 27 per cent of the entire food for the year, and is the most interesting part of the bird's diet from an economic point of view.

When it is examined month by month, the smallest quantity appears in February (less than 3 per cent of the whole food), but as only 8 stomachs were taken in this month the result can not be considered very reliable. In March it rises to one-sixth, and steadily increases till May, when it reaches its maximum of five-eighths of the whole; it then decreases to one-sixth in October, and appears to rise again in November, but the number of stomachs taken in that month is too small to warrant any general conclusions. The great number of insects eaten in May and June is due in part to the fact that the young are fed largely on this kind of food.

Analysis of the insect food presents many points of interest. Among the most important families of beetles are the scarabæids, of which the common June bug or May-beetle and the rose bug are familiar examples. These insects are eaten, either as beetles or grubs, in every month except January and November; in May they constitute more than one-fifth, and in June one-seventh of the entire food. The habit grackles have of following the plow to gather grubs is a matter of common observation which has been fully confirmed by stomach examinations. Many stomachs were found literally crammed with grubs, and in many more, where other food predominated, the hard jaws showed that grubs had formed a goodly portion of a previous meal.

The species most commonly found in the stomach belong to the well-known genus *Lachnosterna*, or common May-beetle, several species of dung-beetles belonging to the genera *Aphodius* and *Atœnius*, and the wonderfully brilliant *Phanœus carnifex*. The last is one of the most conspicuously colored of all the beetles, being clad in green, purple, and gold, which shade to crimson with the changing light. Whether these splendid tints attract the birds' attention, whether there is some peculiarly agreeable flavor to recommend the insects as an article of diet, or whether the simple fact of availability from their great abundance impels the birds to eat them so freely is yet to be determined; but, from whatever cause, a majority of the stomachs of all the grackles taken in the Mississippi Valley during summer contained at least a trace and often the remains of several of these beetles.

Curculios, snout-beetles or weevils, are eaten in every month of the year, but, while they are taken in great numbers, the individuals are so small that the percentage of bulk does not rise as high as in the case of the scarabæids. The maximum is reached in June, when they constitute more than 5 percent of the total food, with a gradual decrease in the succeeding months. Insects of such small size could hardly be obtained except by diligent search, and their presence in so many stomachs (1,059), and also the large numbers in single stomachs (sometimes exceeding 40), warrants the conclusion that they are sought as choice articles of food. The species most often eaten are *Epicœrus imbricatus*, *Phytonomus punctatus*, *Sitones hispidulus*, and more rarely *Sphenophorus zeæ* and other species of *Sphenophorus*. Of this last, commonly known as the corn weevil, 17 were found in one stomach and 14 in another.

Many other beetles were found in the stomachs, but, with one exception, in quantities too small to be of much economic interest. The Colorado potato beetle was not present, but several species belonging to the same family were identified. The one exception just referred to is that of the carabids or predaceous beetles. These valuable destroyers of noxious insects are eaten in every month of the year in varying quantities, but with less variability than most other insects. They constitute more than 7 percent of the food in January, attain a maximum of 13 percent in June, and end with one-half percent in December. From these figures it would seem that they are highly prized by blackbirds; but there are other facts that have a bearing on the case. Most carabid beetles are of fair size and easily seen, and many of them are quite large; moreover, they live on the ground and are much oftener seen running than flying. They are the first beetles observed in spring, and are usually abundant at all times when insects are to be found. Since blackbirds seek a great portion of their food on the ground it is apparent that these beetles must naturally fall in their way oftener than any others, and so are freely eaten, especially

if other food be wanting. They may thus be eaten more from necessity than from choice. It does not, however, necessarily follow that birds are doing harm by eating insects that on account of their food habits are classed as useful. This point has been fully elucidated by other writers, notably by Prof. S. A. Forbes.[1]

Next in importance to beetles as an article of blackbird diet are the grasshoppers. For convenience, grasshoppers, locusts (green grasshoppers), and crickets are considered in the same category, but of the three the true grasshoppers were by far the most numerous in the stomachs, and are eaten in every month except January. They constitute less than 1 percent of the total February food, and the fact that they are found at all in this month indicates that the birds are keen hunters, for it would puzzle an entomologist to find grasshoppers in February in most of the Northern States. It is probable that some of those eaten in this and the succeeding month are dead insects, left over from the previous year. The proportion of grasshoppers in the stomachs increases with each month up to August, when it attains a maximum of 23.4 percent of all the food. It is worthy of note that crickets, considered apart from grasshoppers, reach their maximum in June, when they form a little more than 5 percent of the monthly food.

After August the grasshopper diet falls off, but even in November it still constitutes 9 percent of the total for the month. The frequency with which these insects appear in the stomachs, the great numbers found in single stomachs (often more than 30), and the fact that they are fed largely to the young, all point to the conclusion that they are preferred as an article of food, and are eagerly sought at all times. The good that is done by their destruction can hardly be overestimated, particularly as many of the grasshoppers found in the stomach were females filled with eggs.

Caterpillars form another interesting element of this bird's food. They were found throughout the year, except in November, and average 2.3 percent in each month. In May a maximum of something more than 8 percent is reached, followed by a little less than 4 percent in June, and falling below this through the remainder of the year. The famous army worm (*Leucania unipuncta*) was identified in about half a dozen stomachs.

Most persons who have picked and eaten berries from the bushes have had the disagreeable experience of getting into their mouths a small bug which is a little too highly flavored to suit the taste of the human race, but which is eaten by the crow blackbird in every month from February to October, inclusive. These bugs are not, however, consumed in large quantities, probably for the reason that great numbers can not be found; still, traces of them appear in many stomachs, indicating that the birds eat as many as they find.

[1] Bull. Ill. State Lab. Nat. Hist., Vol. I, No. 3, Nov., 1880.

In addition to the insects specified, representatives of several other orders were found, but not in such large or regular quantities as to render them an important element of food. Hymenoptera are represented mostly by ants, while flies are entirely absent, being probably too lively to be taken by such sluggish birds. Spiders and myriapods (thousand-legs) were noted in sufficient numbers to demand recognition. They are eaten to some extent during every month, but not, as a rule, in large quantities. The spiders attain a maximum of more than 7 percent in May, and not only the spiders themselves, but their cocoons full of eggs appear to be taken whenever found. The myriapods are eaten somewhat less frequently, but appear in nearly every month.

Crustaceans, represented by crayfish, are very commonly eaten, though they do not constitute a large percentage of the food. It often happens that the only trace of these creatures found in a bird's stomach consists of the gastroliths, or 'stomach stones,' which are two saucer-shaped calcareous bodies found one on each side of the crayfish's stomach. One grackle, taken in Iowa, had no less than 26 of these stomach stones in its stomach. It seems hardly probable that this bird had eaten 13 crayfish at one meal or within a very short time, and it is possible that the gastroliths had been picked up on the banks of a pond or stream where the crustaceans had died and left their remains. In addition to crayfish, a few sowbugs (*Oniscus*) were found in some of the stomachs.

Snails of various species, both terrestrial and aquatic, with a few small bivalve mollusks, are also eaten by blackbirds, but, like the crustaceans, they form only a small percentage of the food. It might at first be supposed that these creatures were taken for the sake of the lime in their shells, as an aid in forming the eggshells of the blackbirds, but we find that they are eaten by both adult and young birds, by both sexes and at all seasons, which precludes the idea that the lime is used exclusively for this purpose. Earthworms were found in only a few stomachs, their *setæ* being noticed in a few others; but such soft and probably easily digested creatures are difficult to identify when they have been in the stomach a short time, and so may be easily overlooked.

The vertebrate food of the grackles consists of mice, birds and their eggs, lizards, snakes, frogs and salamanders (newts), and fish. So few remains of mice were found that these mammals can hardly be considered a legitimate article of the birds' diet. Birds and their eggs have been already discussed. Lizards' remains were found in a few stomachs taken in Florida, and the vertebræ of snakes were found occasionally, but not often. Frogs, tree toads, and salamanders are eaten, but not frequently, and do not appear to be a favorite food, or else are not easily taken. The same may be said of the fish whose bones appear now and then in the stomachs.

The vegetable component of the stomach contents is as variable and diversified as the animal food, showing plainly that when one article of diet is wanting the bird can make up the deficiency by eating something else that is more easily obtained. The following list includes all the vegetable substances identified in the stomachs, but there were some that could not be positively determined. The pulp of fruit, when unaccompanied by seeds and already half digested, is difficult to distinguish with precision, and this is also true of the hulls or skins left after kernels of grain have been digested and passed; but the total of such unrecognized matter is not great.

Vegetable substances found in stomachs of crow blackbirds.

Grain:
- Corn.
- Oats.
- Wheat.
- Rye.
- Buckwheat.

Fruit:
- Blackberries and raspberries.
- Strawberries.
- Cherries (cultivated).
- Mulberries.
- Currants.
- Grapes.
- Apples.
- Blueberries and cranberries (*Vaccinium* sp.).
- Huckleberries (*Gaylussacia* sp.).
- Dogwood berries (*Cornus* sp.).
- Elderberries (*Sambucus* sp.).
- Chokeberries (*Aronia arbutifolia*).
- Service berries (*Amelanchier canadensis.*)
- Hackberries (*Celtis occidentalis*).

Seeds and nuts:
- Poison ivy (*Rhus radicans*).
- Harmless sumac (*Rhus glabra et al.*).
- Bayberries (*Myrica cerifera*).
- Hornbeam (*Ostrya virginiana*).
- Chestnuts and chinquapins (*Castanea dentata* and *pumila*).
- Beechnuts (*Fagus atropunicea*).
- Acorns (*Quercus*).

Weeds:
- Ragweed (*Ambrosia*).
- Barngrass (*Chætocloa*).
- Gromwell (*Lithospermum*).
- Smartweed (*Polygonum*).
- Pokeweed (*Phytolacca*).
- Sorrel (*Rumex*).

Miscellaneous:
- Small bulbs or tubers.
- Galls containing larvæ.
- Pieces of plant stems.
- Bits of grass and leaves.
- Thorn of locust (*Robinia*).
- Pieces of rotton wood.

Of all the various items of food, the chief interest centers about the grain and fruit, for it is through their consumption that blackbirds inflict the greatest damage upon the farmer; in fact, the worst that has been said of the grackles is that they eat large quantities of grain. Of the five grains named in the list corn is the favorite, having been found in 1,321 stomachs, or more than 56 percent of the whole number. It is eaten at all seasons of the year; and in every month except January, July, August, and November amounts to more than one-half of the total vegetable food. The corn obtained in winter and until planting in the spring can be but little loss to the farmer, as it must be mostly waste grain. This view was fully confirmed by the contents of a series of stomachs taken in early spring, which consisted to a great extent of corn that had evidently been wet and frozen, and had lain out all winter. After February there is a

decrease in the quantity of corn eaten until July, when it reaches a minimum of 7.7 percent. May shows no increase over the preceding months, although it is the time for planting; nor is there an important increase in June, the month of sprouting corn in the North. In fact, very little evidence was found to indicate that blackbirds pull up sprouting grain. In this respect they differ conspicuously from the crow. In August corn amounts to one-seventh of the whole food, and this, together with a part of that taken in September, is green corn 'in the milk.' The maximum amount, 82 percent, is eaten in February, but this, as already stated, is chiefly waste. In September and October, on the other hand, when corn constitutes 53.2 and 51.5 percent, respectively, of the food totals, it is undoubtedly all taken from the fields of standing corn, representing so much good grain contributed by the farmer; and in the Middle and Western States, where grain often stands in the fields until December, the November corn food must be obtained in the same way.

Oats, which are eaten in very irregular quantities in every month except January, November, and December, form much less of the food than corn. They appear in the greatest amount in April (a little more than one-seventh of the total food), fall to less than 1 percent in June, but rise to more than 9 percent in August. The oats eaten in April are probably picked up from newly sown fields, and it is likely that those taken in August and September are gleaned from fields after harvest, while those found in the other months are accidental and of no importance.

Wheat is eaten in every month from April to September, inclusive, but makes very little showing except in July and August, when it forms 26 percent of the whole food, these being the only months of the year in which it reaches a higher percentage than corn. As July and August are the months of the wheat harvest, it is easy to account for the large amount eaten at that time; but whether the grain so eaten is taken from the standing crop, or consists merely of scattered kernels gleaned after the harvest, is not manifest from stomach examination. Probably the birds take whichever is more accessible.

Rye was found in only one stomach and buckwheat in nine. The former was from a bird taken in May in Pennsylvania, and is evidently not a favorite food. Three birds taken in New Jersey in February were found to have eaten a small quantity of buckwheat. A single bird killed in July in New York and one killed in September in Iowa had also eaten this grain, as had four birds that were all taken at once in November in New Jersey. The buckwheat eaten in February and November must have been waste grain, and the fact that birds from the same localities, taken at the time when this grain was harvested, had not eaten it, indicates that it is not a desirable food and is eaten only under stress of hunger.

According to reports from the Southern States, crow blackbirds prey upon rice in company with other blackbirds and the bobolink, but unfortunately the collection contains few stomachs from this region, so that no corroborative evidence is at hand.

Although fruit of some kind is eaten in every month from March to December, inclusive, it does not become important until June. In June, July, and August it reaches 7, 13, and 10 percent, respectively. This aggregate is made up from a number of elements (see p. 64), but the only ones likely to possess any economic interest are blackberries, raspberries, cherries, currants, grapes, and apples. Apple pulp was found in 3 stomachs, grapes in 3, currants in 1, cherries in 37 in June and 14 in July, and strawberries in 7. The blackberries and raspberries were the favorites, and made up the great bulk of the fruit eaten. They were eaten from May to September, inclusive, but only a few in each month, except in July and August, when they were found in 96 and 68 stomachs, respectively. When we consider that the latter fruits are much more abundant in the wild than in the cultivated state, and bear in mind the small amount of other fruit eaten, it certainly must appear that the damage to fruit by crow blackbirds is of no great moment. None of the wild fruits mentioned in the table were found in large quantities or in many stomachs.

Mast, under which term are included chestnuts, chinquapins, acorns, and beechnuts, forms quite an important element in the fall and early spring months. It constitutes the principal part of the vegetable food of the 7 stomachs taken in January and does not appear in the 8 February stomachs to an important extent; but this record, based on only 15 stomachs, can not be considered very reliable. It composes about 10 percent of the March food, but decreases through the ensuing months till September, when it again becomes an important element and so continues through the rest of the year.

Weed seeds form another interesting element of vegetable food and are of considerable importance in the colder months. Beginning in February, they constitute more than 7 percent of the food, increase slightly in March, and then gradually diminish until they almost disappear in June, but again increase to a maximum of more than 11 percent in October. As all the plants included in this category are nuisances, it is, perhaps, needless to say that by eating their seeds the birds are doing good work.

The mineral component of the stomach contents possesses little, if any, economic interest, but it is curious to note how many different things a blackbird can pick up. Sand, gravel, pieces of brick, bits of mortar, plaster of paris, charcoal, hard coal, and cinders were the most common of the various hard substances which helped to line the mill in which their grist was ground. A glass bead was found in one stomach. Much of the gravel from stomachs of birds taken in

Kansas was found to contain fossil remains of corals, crinoid stems, shells, etc.

As previously stated, 456 nestlings are included in the 2,346 birds whose food has been already discussed. A separate study was made of these, in order to ascertain in what respect, if any, their food differed from that of the adults. It would have given more satisfactory results if it had been possible to separate the younger nestlings—say those under 1 week of age—from the older ones, for it was noticed that as the young approach maturity and get ready to fly, their food becomes more like that of their parents. The young were collected from May 22 to June 30, inclusive, and represent every age, from the newly hatched to those about to leave the nest. The whole food, when separated into its two principal components, was found to be as follows: Animal matter, 74.4 percent; vegetable, 25.6 percent. The much higher percentage of animal food in the young as compared with the adults (30.3 percent) is at once noticeable, although it may be insisted that the food of the young should be compared with that of the adults in the corresponding season; that is, in the months of May and June. If this view be taken, the difference is not so great. The percentage of mineral matter in the stomachs is also a little greater than in the case of adults.

The animal food is practically the same as that of the parent birds, and likewise consists chiefly of insects. These amount to 70 percent, 43 percent more than in the adults. The animal food other than insects, amounting to less than 5 percent, is not important enough to merit attention. The insect food is made up of about the same kinds as are eaten by the old birds, but in somewhat different proportions. Adult beetles, on account of their hard shells, are not fed to very young birds, but a few are given to the older ones. Grubworms (the larvæ of scarabæids) are fed freely after the first or second day. A little more than 19 percent of the food of the nestlings consists of this family of beetles, and for the most part in the form of the larvæ or grubs. Predaceous beetles (carabids) constitute about 10 percent of the food, weevils a little more than 3 percent, and there were traces of five or six other families, none of which reached 1 percent.

Grasshoppers and crickets, the former predominating, are a favorite food for the young, being softer and more easily digested than beetles. They constitute more than 21 percent of the total food. This is nearly as much as the parent birds consume in August, and three times as much as they eat in May and June, when they are feeding the young. This shows that they select the grasshoppers and other soft insects for their offspring, while they eat beetles and other hard things themselves.

Caterpillars constitute 6 percent of the food of the young birds, which is not as much as might be expected when we consider how soft and apparently well adapted they are for this purpose.

Besides the insects already mentioned, small quantities of ants, flies, bugs, May-flies, myriapods, and spiders were given to the young. These last merit a special notice from the fact that they form the earliest food of the bird. A number of tiny stomachs were examined, evidently taken from birds less than 24 hours old. In nearly every case they contained either a single spider or several very small ones—undoubtedly the bird's first meal. The very young stomachs are thin, almost membranous sacs, entirely unlike the stout, muscular gizzards of the adult birds, which explains why soft, easily crushed food is required for the newly hatched young. It is only after they have attained considerable growth and the stomach walls have become somewhat muscular that they are able to digest such food as hard beetles and corn.

The vegetable food of the young consists of corn and fruit, with mere traces of half a dozen other things. Corn amounts to 15 percent of the total food, but is fed only to the older birds, whose stomachs have acquired the requisite muscular strength to digest it. Fruit constitutes about 7 percent of the food, almost exactly the same quantity as is consumed by the adults in the month of June, and consists of the same varieties.

SUMMARY.

From the foregoing results it appears that the food of the crow blackbird for the whole year consists of animal and vegetable matter in quite unequal proportions. Of the animal component, nine-tenths are insects, and of the insects two-thirds are noxious species. The charge that the blackbird is a habitual robber of other birds' nests seems to be disproved by the stomach examinations.

Of the vegetable food it has been found that corn constitutes more than half and other grain less than one-seventh. Oats are seldom eaten except in April and August, and wheat is taken chiefly in July and August. Fruit is eaten in such moderate quantities that it has no economic importance, particularly in view of the fact that so little belongs to cultivated varieties.[1]

The farmer whose grain is damaged, if not wholly ruined, by these birds, may attempt to count his loss in dollars and cents, but the good services rendered by the same birds earlier in the season can not be estimated with sufficient precision for entry on the credit side of the ledger. And although the number of useful predaceous beetles they destroy is rather large, yet it must be considered that the final value of useful birds depends not so much on the character of the insects they destroy as on the extent of their work in keeping the great tide of

[1] In the appended table blackberries, raspberries, and other fruits of the genus *Rubus* are classed as cultivated fruit, since it is impossible to distinguish the wild from the cultivated in stomach examinations; but probably by far the greater part comes from wild plants.

insect life down to a proper level. The examination of the food of the blackbirds has shown that they do a good share of this work, and are therefore most emphatically useful birds—so useful that no general war of extermination should be waged against them. This does not mean that they do no harm, or that they should be permitted to do harm without restraint. A bird whose diet contains 46.5 percent of grain must be capable of considerable damage in any section of country where grain is an important crop; and when blackbirds descend upon a corn or wheat field in flocks of hundreds or thousands, they inflict a real loss, from which the farmer should protect himself by any practicable means. Still, crow blackbirds have not been complained of so much as redwings, and they probably do not ordinarily cause much loss to the farmer, since such a large part of the grain they eat consists of scattered or waste kernels. The local ravages they commit are usually due to overcrowding in a restricted area, and when this occurs there is no doubt that their numbers should be reduced.

The following table shows the percentage of each article of diet for each month:

Food of the crow blackbird.

[NUMBER OF STOMACHS EXAMINED: January, 7; February, 8; March, 53; April, 289; May, 348; June, 887; July, 346; August, 197; September, 81; October, 111; November, 11; December, 8. Total, 2,346.]

Food.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average.
ANIMAL.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Pred. beetles	7.1	0.3	4.3	6.3	8.5	12.9	11.1	9.1	3.1	2.6	1.5	0.5	5.6
May-beetle family	.....	0.1	3.2	6.8	22.0	15.1	8.0	0.8	0.6	0.5	.....	1.6	4.9
Snout-beetles	2.9	0.3	1.2	1.8	3.5	5.3	4.4	2.1	1.4	0.4	0.1	0.7	2.0
Other beetles	2.3	.....	1.2	1.3	1.7	1.9	1.3	0.9	0.5	0.1	.....	0.6	1.0
Caterpillars	4.3	0.3	1.2	2.3	8.2	3.6	1.2	0.7	1.3	1.3	.....	3.1	2.3
Grasshoppers	.....	0.6	0.8	1.2	8.8	14.6	12.7	23.4	8.1	6.9	9.0	1.9	7.3
Other insects	3.0	0.3	3.8	2.9	3.2	2.9	4.8	1.9	1.7	2.3	0.5	0.4	2.3
Spiders and myriapods	1.0	0.5	0.6	2.3	7.4	2.9	1.3	0.5	0.4	0.6	0.5	0.6	1.5
Crustaceans and mollusks	11.7	.....	0.1	1.6	1.9	2.4	0.9	0.2	2.6	2.3	9.9	3.1	3.1
Vertebrates	.....	.....	1.2	0.3	0.7	0.5	0.2	0.1	0.6	[1]Tr.	.....	.....	0.3
Total animal food	32.3	2.4	17.6	26.8	65.9	62.1	45.9	39.7	20.3	17.0	21.5	12.5	30.3
VEGETABLE.													
Corn	1.4	82.0	58.4	40.9	27.2	28.2	7.7	14.0	53.2	51.5	35.4	47.3	37.2
Oats	.....	1.2	0.9	14.5	2.2	0.4	5.2	9.3	1.1	0.8	.....	.....	2.9
Wheat	.....	.....	.....	1.2	0.6	0.2	26.1	25.9	0.8	.....	.....	.....	4.8
Other grain	.....	6.7	.....	0.6	0.3	.....	0.2	.....	[1]Tr.	0.8	10.5	.....	1.6
Domestic fruit	.....	.....	0.4	.....	[1]Tr.	5.8	10.3	9.1	1.3	0.4	.....	8.2	2.9
Wild fruit	.....	.....	1.7	1.2	0.4	1.3	2.7	1.3	1.5	2.2	4.5	8.1	2.1
Weed seed	.....	7.3	10.6	6.2	0.4	[1]Tr.	0.6	0.3	2.5	11.6	11.6	.....	4.2
Mast, etc	66.3	0.4	10.4	8.6	3.0	2.0	1.3	0.4	19.4	15.7	16.5	23.9	14.0
Total vegetable food	67.7	97.6	82.4	73.2	34.1	37.9	54.1	60.3	79.8	83.0	78.5	87.5	69.7

[1]Tr. = trace.

The following is a list of the various insects identified in the stomachs of crow blackbirds:

Insects found in stomachs of crow blackbirds.

COLEOPTERA.

Cicindela punctulata.
Cicindela purpurea.
Cychrus sp.
Carabus sp.
Calosoma scrutator.
Calosoma calidum.
Calosoma externum.
Pasimachus depressus.
Scarites subterraneus.
Amara sp.
Chlænius sp.
Agonoderus pallipes.
Harpalus caliginosus.
Harpalus pennsylvanicus.
Helophorus inquinatus.
Olophrum convexum.
Scymnus sp.
Hister americanus.
Ips quadriguttatus.
Drasterius elegans.
Drasterius dorsalis.
Podabrus rugulosus.
Canthon sp.
Phanæus carnifex.
Onthophagus hecate.
Onthophagus pennsylvanicus.
Atænius sp.
Aphodius fimetarius.
Aphodius inquinatus.
Bolbocerus farctus.
Geotrupes sp.
Dichelonycha elongata.
Macrodactylus subspinosus.
Lachnosterna sp.
Anomala varians.
Ligyrus gibbosus.
Allorhina nitida.
Euphoria fulgida.
Euphoria inda.
Cremastochilus sp.
Prionus sp.
Strangalia sp.
Cryptocephalus venustus.
Typophorus canellus.
Colaspis brunnea.
Chrysomela pulchra.
Gastroidea polygoni.
Haltica sp.
Dibolia sp.
Coptocycla signifera.
Eleodes tricostata.
Epicærus imbricatus.
Phytonomus punctatus.
Sitones hispidulus.
Lixus sp.
Balaninus sp.
Sphenophorus zeæ, et al.
Calandra granaria.

LEPIDOPTERA.

Leucania unipuncta.
Deilephila lineata.

HEMIPTERA.

Euschistus sp.
Prionidus cristatus.

NEUROPTERA.

Corydalis cornutus.

THE BOAT-TAILED GRACKLE.

(*Quiscalus major.*)

The boat-tailed grackle, one of the largest of the blackbirds in the United States, inhabits the South Atlantic and Gulf States from Virginia to Texas, and is not found at any great distance from the coast.

Its food habits have received but brief consideration from ornithological writers. Audubon, whose account is apparently the best, says:

> The food of this species consists principally of those small crabs called "fiddlers," of which millions are found along the margins of the rivers and mud-flats, as well as of large insects of all kinds, ground-worms, and seeds, especially grains. * * * In autumn, while the rice is yet in the stack, they commit considerable mischief by feeding on the grain, although not so much as when it is in a juicy state, when the planters are obliged to employ persons to chase them from the fields.[1]

In the preliminary investigations made by the Biological Survey there have been examined 116 stomachs from Florida, Georgia, and Texas, representing every month in the year (see p. 76). The food consists of 39.8 percent of animal matter and 60.2 percent of vegetable matter. The former is made up of insects and crustaceans, with a few lizards, batrachians, small mammals, etc. Crustaceans amount to about two-fifths of the animal food (15.6 percent of the total food), and consist of crayfishes, crabs, and shrimps, which plainly indicate the littoral habits of the species. No insects appear to be specially sought. Predaceous beetles (Carabidæ) are eaten to the extent of 3.3 percent and are taken mostly in fall. Other beetles are eaten to some extent, but no family is conspicuous. Grasshoppers are eaten in July and August, to the extent of 31.9 and 47.7 percent, respectively, but very few in any other month. The average for the year is 7.3 percent. Various other insects form 9.7 percent of the food, but no order is especially prominent. Six birds taken in Texas in September are worthy of special mention from the fact that they had all eaten cotton-ball worms (*Heliothis armiger*) in quantities varying from 26 to 93 percent of the food. While remains of small vertebrates are frequent in the stomachs, they do not form an important element.

Grain constitutes 46.8 percent of the total food. Of this all but a mere trace is corn, which composes part of the food of every month except May—the only stomachs collected in this month came from a rice field at Savannah, Ga., where corn was probably not readily obtainable. In each month except May and November corn constitutes more than half of the vegetable food, and in March, April, and August it is the only vegetable matter taken. April shows the greatest amount (92.7 percent of the total food), but as only 3 stomachs were taken in this month, this result can hardly be regarded as a fair average. The pulp of some large seed or nut, not otherwise identified, was the most important element next to corn. The remains of figs were found in several stomachs and wild grapes in one, which indicates that fruit is eaten, though sparingly. No weed seed was found in any of the stomachs.

---

[1] Ornith. Biog., Vol. II, p. 504, 1835.

SUMMARY.

In summing up the results of the stomach examinations it is evident that no very salient points in favor of the boat-tailed grackle have come to light. In its insect food it has no very pronounced preferences, and while it does not cause any great havoc among useful insects, it does not prey extensively upon harmful ones. In common with most other land birds, it eats grasshoppers freely in July and August, and it would probably eat caterpillars as well if it found them more plentiful than other food. The animal food it decidedly prefers is small crustaceans, and these, so far as the interests of agriculture are concerned, are entirely neutral.

In its vegetable diet, the bird certainly does not commend itself to the agriculturist. Its preference for corn is very marked and shows no variance with the change of season. That it visits the growing crop for its supplies is evident from the fact that much of the corn found in the stomachs during the early summer was 'in the milk.' In any locality, therefore, where this grackle is very abundant it must almost necessarily be harmful to the corn crop without rendering any well-defined service in return.

DISTRIBUTION OF STOMACHS.

Distribution of stomachs, by months and States.

BOBOLINK.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Connecticut					12	1	8	4					25
Dist. of Columbia								4	17				21
Georgia					2				7				9
Iowa					2								2
Kansas					4								4
Massachusetts					3	2	4						9
Michigan					2								2
Minnesota					2	4	1	3					10
Montana								9					9
New Jersey								10					10
New York					11	10	6	34	1				62
North Dakota						1	7	13					21
Pennsylvania					4	20	9	10	5				48
Rhode Island							3						3
South Carolina									2				2
South Dakota							2						2
Texas					3								3
Virginia					3			1	15				19
West Virginia									1				1
Wisconsin					3	3	2	7	2				17
Ontario, Canada					1		3	8					12
Total					52	41	45	103	50				291

Distribution of stomachs, by months and States—Continued.

COWBIRD.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Arizona					1	1							2
Connecticut				7	3				1				11
Dist. of Columbia											3		3
Georgia			4										4
Illinois			2	1	2								5
Iowa				6	4	1	3			1			15
Kansas			2	36	54	24	10	5	2				133
Kentucky										2			2
Maine								1					1
Maryland							1						1
Massachusetts				5	6		2						13
Michigan							1						1
Minnesota					5	3		1					9
New Jersey			1	5		1		6	7		2		22
New York				7	10	3	7	6	63	8			104
North Dakota							4	9					13
Ohio				4			2						6
Pennsylvania			6	6	9	15	22	6	1	5	1		71
Rhode Island							1		1				2
South Dakota					1		2						3
Tennessee											1		1
Texas	3	10	2	3		2	1	3	4	54	16	2	100
Virginia												9	9
West Virginia								1					1
Wisconsin			1	3	1	3	1						3
Canada					3								3
Total	3	10	18	83	99	53	57	38	79	70	23	11	544

YELLOW-HEADED BLACKBIRD.

California					1								1
Iowa					1								1
Kansas				5	13								18
Michigan										3			3
Minnesota					11	10	9	28					58
Nebraska				1	1								2
North Dakota						4	3	24	4				35
South Dakota					1								1
Texas				3									3
Wisconsin							4	7					11
Wyoming								1	1				2
Northwest Territory, Canada					3								3
Total				9	31	14	16	60	5	3			138

Distribution of stomachs, by months and States—Continued.

RED-WINGED BLACKBIRD.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Arizona					8								8
California		1		2									3
Connecticut			3	5	6		6						20
Dist. of Columbia		2		1			2	4		4	4		17
Florida				2									2
Georgia					2								2
Illinois			5	3	2								10
Indiana							3						3
Iowa			5	5	2			1		40			53
Kansas			10	15	4	19	22						70
Maryland			1	2	3	54	11	22	2				95
Massachusetts	1			7	5	14	2						29
Michigan					1								1
Minnesota				2	12	5	13	21	2	2			57
Missouri			1										1
Nebraska				1	1			1					3
New Jersey			8	6	1						2		17
New York			2	9	14	12	8	7	2	4	1		59
North Dakota						2	6	42	1				51
Ohio				1									1
Pennsylvania			10	28	5	41	51	45	4	2			186
Rhode Island							1						1
South Carolina			1										1
South Dakota			3		2			2					7
Texas	10	45	34	11		8	11	1	31	29	70	81	331
Utah										2			2
Vermont										1			1
Virginia						1	5		8	5	5	1	25
West Virginia								2	4	1			7
Wisconsin			1	1	4	2			2				10
Wyoming								2					2
Ontario, Canada				3	3			1		1			8
Total	11	48	84	104	75	158	141	151	56	91	82	82	1,083

CALIFORNIA RED-WINGED BLACKBIRD.

California	2		3	2		13	1		2	18	13	7	61

RUSTY BLACKBIRD.

Connecticut			3	4						4			11
Dist. Columbia				1							4	1	6
Georgia			3										3
Illinois			1	6									7
Iowa				2	2					1			5
Kansas	1		5	20						5	5		36
Massachusetts			2	2	1					3			8
Minnesota				3					1	1			5
New Jersey											2		2
New York			1	4	4				2	8		1	20

Distribution of stomachs, by months and States—Continued.

RUSTY BLACKBIRD—Continued.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
North Dakota									1				1
Ohio										1			1
Pennsylvania				5							1		6
Texas		6									2	1	9
Virginia			1								1		2
West Virginia										1			1
Wisconsin				2									2
Nova Scotia								4					4
Ontario, Canada			1						1	1			3
Total	1	6	17	49	7			4	5	25	15	3	132

BREWER'S BLACKBIRD.

California	7	1	4		1	10	9		7	14	10	6	69
Montana								12	13				25
North Dakota							1	8	18				27
South Dakota					6								6
Texas		6										9	15
Wyoming								4					4
Total	7	7	4		7	10	10	24	38	14	10	15	146

CROW BLACKBIRD.

Alabama											1		1
Connecticut			9	23	12	8	6			1			59
Dist. of Columbia			1	1	7	15	48	9		9	1		91
Florida			2	3				3		1		1	10
Illinois			2	7	8		9	3		4			33
Indiana				2	1		1						4
Iowa				10	4		1	2	12	10			39
Kansas			1	67	217	570	29		6	6			896
Kentucky					1					4			5
Louisiana					3								3
Maine				1						1			2
Maryland			1	28	3	210	159	152	3		2		558
Massachusetts				10									10
Michigan				6	2								8
Minnesota				2	3	6	2						13
Missouri				1									1
Nebraska				3					2	20			25
New Jersey		3	1	11	1		1		5		5		27
New York			7	17	17	11	1	1	29	9			92
North Dakota								6					6
Ohio				2		2	4	3	18				29
Pennsylvania			20	94	62	63	72	12	6	45	1		375
South Dakota				1						1			2
Tennessee					2							1	3
Texas	7	5	4		2	2						6	26
Virginia			2				11	3					16

Distribution of stomachs, by months and States—Continued.

CROW BLACKBIRD—Continued.

States.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
West Virginia	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	3
Wisconsin	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	3
Ontario, Canada	.....	.....	3	.....	.....	.....	2	.....	.....	.....	1	.....	6
Total	7	8	53	289	348	887	346	197	81	111	11	8	2,346

BOAT-TAILED GRACKLE.

Florida	1	.....	.....	.....	.....	.....	.....	2	1	1	.....	.....	5
Georgia	.....	.....	.....	.....	8	.....	.....	.....	.....	.....	.....	.....	8
Texas	23	20	3	3	.....	12	14	2	8	4	5	9	103
Total	24	20	3	3	8	12	14	4	9	5	5	9	116

INDEX.

HOW BIRDS AFFECT THE ORCHARD

BY

F. E. L. BEAL, B. S.
Assistant Biologist, Biological Survey

[REPRINT FROM YEARBOOK OF DEPARTMENT OF AGRICULTURE FOR 1900.]

HOW BIRDS AFFECT THE ORCHARD

BY

F. E. L. BEAL, B. S.

Assistant Biologist, Biological Survey

[Reprint from Yearbook of Department of Agriculture for 1900.]

CONTENTS.

ILLUSTRATIONS.

HOW BIRDS AFFECT THE ORCHARD.

By F. E. L. Beal, B. S.,
Assistant Biologist, Biological Survey.

INTRODUCTION.

That birds sometimes inflict injuries upon orchard trees and their products is a fact with which every fruit grower is familiar; but it is not so well known that they are frequently of great service in destroying enemies of the orchard, and yet the aid they render in this subtler way far more than offsets the harm that is so apparent.

The enemies with which the fruit grower has to contend, aside from the elements and the birds themselves, may be divided into three categories: Vegetable parasites, such as fungi and bacteria; certain mammals, such as rabbits and mice; and insects of various kinds. Against vegetable foes birds afford little, if any, protection. Their efficiency is shown in the destruction of noxious mammals and insects. The value of their work in dollars and cents is difficult of determination, but careful study has brought out much of practical importance in ascertaining approximately to what degree each species is harmful or helpful in its relation to the orchard.

SOME BIRDS IMPORTANT TO THE FRUIT GROWER.

WOODPECKERS.

Among birds which most directly affect the interests of the fruit grower may be mentioned woodpeckers, of which about 45 species and subspecies are found within the limits of the United States, all of decided economic importance. Their subsistence is obtained for the most part upon trees, a mode of life for which they are specially adapted. The character of the feet and tail enables them to cling easily to upright trunks, and the structure of the bill and tongue gives them the power to cut into solid wood and withdraw the insects lodged inside. The toes are in pairs, one pair projecting forward and the other backward, and are furnished with very strong, sharp claws, an arrangement which insures a firm hold upon the bark. The tail is composed of very stiff feathers pointed at the end, that can be pressed against the tree trunk, and thus made to support and steady the bird. The beak is rather long, but stout, and furnished with a chisel-shaped point, which is hardened and sharpened so as to render it a most effective wood-cutting instrument. The tongue, the most peculiar portion of the anatomy of these birds, is extended backward by two

slender, flexible filaments of the hyoid bone, each incased in a muscular sheath (fig. 34, *a*). These filaments, instead of ending at the back of the mouth, curve up over the back of the skull, across the top of the head, and down on the forehead, and in some species enter the opening of the right nostril, and extend forward to the end of the beak (fig. 35). In the last case the tongue is practically twice the length of the head. By means of its surrounding muscular sheath, the tongue can be protruded from the bird's mouth a considerable portion of its length, and can thus be inserted into the burrows of wood-boring larvæ. In order to secure grubs or other insects, it is usually furnished with a sharp point and is barbed on the sides (fig. 34, *b*). It is evident that a bird possessing such an apparatus must be capable of doing work which less advantageously endowed species can not accomplish. Hence, while most birds content themselves with eating such insects as they find upon the surface, woodpeckers seek those larvæ or grubs which are beneath the bark, or even in the very heart of the tree. To render more effective the mechanism here described, these birds are gifted with a remarkably acute sense of hearing by which to locate their prey within the wood. That they do so with great accuracy, is disclosed by examination of their work, which shows that they cut small holes directly to the burrows of the grubs.

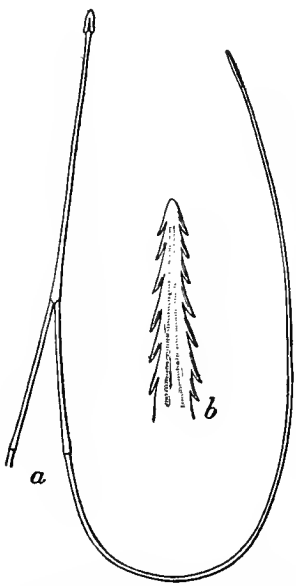


FIG. 34.—Tongues of woodpeekers: *a*, hyoid of flicker (*Colaptes auratus*); *b*, tip of tongue of downy woodpecker (*Dryobates pubescens*).

DOWNY WOODPECKER.—Of the various species of woodpeckers in the Eastern States, the two most important are the so-called downy and hairy woodpeckers. These birds are especially given to foraging in orchards, more particularly in winter; for, unlike most species, they do not migrate, but remain on their range the year round.

A study of the contents of the stomachs of many specimens of the downy woodpecker (*Dryobates pubescens*) shows that nearly one-fourth of the yearly food consists of ants. A celebrated French writer upon popular natural history has spoken of the ant as "the little black milkmaid, who pastures her green cows in the meadow of a rose leaf." This is a graphic, if somewhat fanciful, picture of the relations of ants and plant lice (Aphidæ); but unfortunately the black milkmaid does not limit her pastures to the rose-leaf meadows. There are comparatively few plants which do not suffer to some extent by the ravages of plant lice, and fruit trees and ornamental shrubs seem to be more

especially subject to their attacks. Ants protect these plant lice from harm, and, when the plant on which they are feeding is exhausted, carry them to fresh pastures, and in some cases actually build shelters over them. Besides destroying the ants, the downy woodpecker eats many of the plant lice.

Again, when the woodpecker has, by its keen sense of hearing, located the larva of a wood-boring beetle in a tree, and dislodged it with the aid of the sharp-edged chisel and probe, there is much likelihood that the next time it visits the tree it will find a colony of ants snugly established in the burrow of the defunct grub, whose somewhat limited quarters they are extending in every direction. It now brings to bear upon the ants the same apparatus it used in the case of the grub, and they are soon drawn out and devoured. From these two sources are obtained the ants that are found in the food of this bird, and that constitute 23 per cent of that food. In both cases the insects are harmful, and the woodpecker stops the injury and benefits the tree.

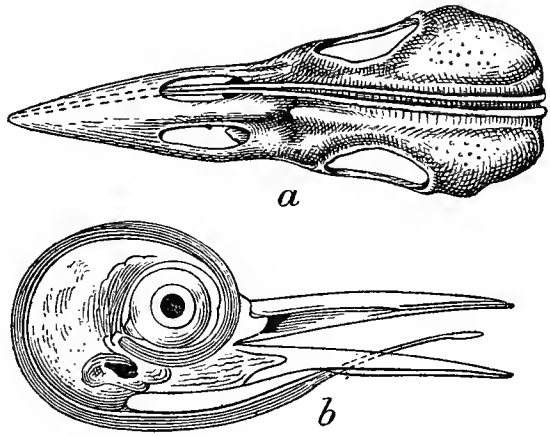


FIG. 35.—Special development of tongues of woodpeckers: *a*, skull of flicker (*Colaptes auratus*), showing root of tongue extending to tip of bill (after Lindahl); *b*, head of hairy woodpecker (*Dryobates villosus*), showing root of tongue curving around eye (after Audubon).

Of the food of the downy woodpecker, 13 per cent consists of wood-boring coleopterous larvæ, insects that do an immense amount of damage to fruit and forest trees, and are, as stated, protected from the attacks of ordinary birds by their habit of burrowing in trees. Besides the grubs taken from within the wood, the woodpecker eats many of the parent insects from whose eggs these grubs are hatched. It also destroys numerous other species that live upon the foliage and bark. Caterpillars, both those that bore into the tree and those that live upon the leaves, constitute 16 per cent of its food, and bugs that live on berries and give to them such a disagreeable taste form a considerable portion of its diet. Bark lice or scale insects (Coccidæ), pests of the worst description, are also eaten by this bird, and to an extent that is surprising when their minute size is considered.

HAIRY WOODPECKER.—The hairy woodpecker (*Dryobates villosus*, fig. 36) subsists on food that is similar in general to that of the downy; and although it does not eat quite so many ants, it destroys more

beetle larvæ and more caterpillars, and thus renders quite as good service in the orchard. In winter, birds of both these species are more pressed for food than in summer, and may be seen busily searching the crevices in the bark, where they find hibernating insects and insects' eggs. By devouring these they destroy many enemies that would have attacked the trees at the approach of warm weather.

FIG. 36.—Hairy woodpecker (*Dryobates villosus*).

FLICKER.—The flicker (*Colaptes auratus*, fig. 37), another member of the woodpecker family, is well known to most orchardists and farmers. It is larger than either the downy or the hairy woodpecker, and differs somewhat from them in its food habits. It eats fewer beetles and caterpillars, but devours an enormous number of ants. Two stomachs were examined, each of which contained more than 3,000 ants, and in a third were 5,000, of a very minute species. Not all of these ants, however, are obtained from trees; many are species that burrow in the earth, for the flicker is more terrestrial than most of the other woodpeckers, and takes much of its food from the ground.

FIG. 37.—Flicker (*Colaptes auratus*).

YELLOW-BELLIED WOODPECKER.—On the other hand, some harm to fruit trees is to be charged against this family, though there is much popular misapprehension in this regard. The smaller species have been called sapsuckers, from the supposition that they puncture holes in the bark of trees in order to get the sap and soft inner bark. The charge is well grounded, but only one species, so far as known, causes any appreciable harm through the practice. This is the yellow-bellied woodpecker (*Sphyrapicus varius*, fig. 38), whose summer range is confined to Canada, the northern portions of the United States, and the Alleghany Mountains, and whose winter residence is in the Southern States. This bird is injurious to certain trees, at times removing the outer bark over a considerable area, and at others pecking numerous holes very close together, in each case practically girdling the tree. As the sap collects in the pits thus formed, the bird drinks it, and also catches the insects that are attracted to the pits by the sweetness

FIG. 38.—Yellow-bellied woodpecker (*Sphyrapicus varius*).

of their contents. The trees attacked, mostly birches, mountain ashes, maples, and apple trees, often die the first or second year after the girdling is done. Fruit trees, however, are not very frequently attacked by this bird, and the species is not numerous enough to cause any perceptible harm to the forest. Examination of the stomachs of yellow-bellied woodpeckers shows that alburnum, or the soft tissue lying between the inner layer of bark and the hard wood of the tree, constitutes quite an important item of the diet, 23 per cent of the food of the year. Other woodpeckers also eat sparingly of the same substance, but the little they take is of no practical importance.

RED-BELLIED WOODPECKER.—The red-bellied woodpecker (*Melanerpes carolinus*), which is not common in the East north of Pennsylvania, has fallen into disrepute among the orange growers of Florida by its attacks on oranges. It does considerable damage by pecking holes in the ripe fruit, and sometimes causes serious loss. It is to be hoped that experience will show some way to prevent these ravages without destroying the bird, for its harmfulness is confined to the orange groves of Florida, and it is of much value elsewhere.

OTHER WOODPECKERS.—The other woodpeckers, both eastern and western, are all more or less useful to fruit raisers. In the West and South, besides several subspecies of the hairy and downy woodpeckers, are other members of the same genus (*Dryobates*), which have food habits, as shown by stomach examination, that closely approximate those of the hairy and downy. These include the red-cockaded (*D. borealis*), Texan (*D. scalaris bairdi*), St. Lucas (*D. scalaris lucasanus*), Nuttall's (*D. nuttalli*), and Arizona (*D. arizonæ*). Several woodpeckers belonging to the genus *Picoides*, that inhabit the northern part of the country and beyond, are equally useful. The genus *Melanerpes*, with its half dozen species, covers practically the whole United States, and, like the genus *Dryobates*, is a group of useful insectivorous birds, with the possible exception noted above. In the West three species of flickers are found whose food is practically the same as that of the eastern species.

TITMICE.

BLACK-CAPPED CHICKADEE.—The well-known titmice, or chickadees, though small in size and unobtrusive in habits, do much good in both orchard and forest. So far as known, the food habits of all are beneficial. The winter food of the familiar black-capped chickadee (*Parus atricapillus*), which has been investigated by Prof. Clarence M. Weed,[1] of New Hampshire, and by the Biological Survey, consists of noxious insects, and more especially of insects' eggs. The eggs of plant lice (Aphidæ) were found in a large proportion of the stomachs examined, and constituted an important percentage of the food. Besides these,

[1] Bulletin 54, N. H. College Agr. Exp. Sta., June, 1898.

the eggs of such pests as the common tent caterpillar (*Clisiocampa americana*), the forest tent caterpillar (*C. disstria*), and the fall canker-worm (*Anisopteryx pometaria*) are eaten. In winter chickadees spend most of the daylight hours in searching trunks and branches of trees, inspecting every crevice in the bark and examining every bud for the insects' eggs and hibernating insects, which constitute so large a part of their food.

Mr. E. H. Forbush, ornithologist to the Massachusetts State board of agriculture, has shown how these birds may be attracted to the orchard in winter by hanging up pieces of suet, or bones with a little meat still attached to them.[1] In this way they are induced to leave the woods and live in the orchard during the winter, and finally to build their nests and rear their young there.

CALIFORNIA BUSH-TIT.—Other species of titmice are quite as useful as the black-cap. Examination of the stomachs of a number of California bush-tits (*Psaltriparus minimus*) revealed the presence in considerable number of the black scale (*Lecanium oleæ*), which infests the olive. This insect has been a serious pest to the olive trees on the Pacific coast, and any bird that will destroy it should certainly be encouraged by Western fruit growers. The usefulness of titmice depends largely upon the small size of the birds. In dealing with pests of any kind, the more minute they are the less the probability that man can by his own unaided efforts succeed in exterminating them. Plant lice and bark lice are, on this account, difficult of destruction by human agency, and are too small to attract the attention of many of our ordinary birds; but to the chickadees they must appear of considerable size, and so are easily found and eaten. The eggs of insects, especially those of such small species as plant lice, are often so minute as to escape the closest search by man; but the more microscopic eyes of these small birds detect them even in crevices of buds or bark.

NUTHATCHES AND CREEPER.

Frequent associates of the chickadees, and doing practically the same work, are the nuthatches and the brown creeper. The nuthatches are of about the same size as the chickadees, but are more agile tree climbers, in this respect excelling all other North American birds. While woodpeckers and titmice usually run up the trunks, nuthatches run up or down, or along the underside of a horizontal branch, with equal facility, and do not depend upon the tail for support. The brown creeper, like the chickadee, is constantly engaged during the day in searching for insects' eggs and small insects in the crevices of the bark. It is an active, nervous little creature, which flits rapidly from one tree to another, generally alighting upon the trunk near the

[1] Mass. Crop Reports, p. 349, 1895.

base, then running spirally upward, and, after a hurried inspection, winging its way to the next tree. These three birds perform a service which it is difficult for man to do for himself, and they should be protected and encouraged.

CUCKOOS.

Probably no group of insects contains a greater number of orchard pests than the order Lepidoptera, which comprises butterflies and moths, with their larvæ, or caterpillars. Tent caterpillars, cankerworms, fall webworms, tussock moths, codling moths, and a host of others are among the worst enemies of the fruit grower. It is, therefore, fortunate that there are in the United States two birds that subsist, to a great extent, upon caterpillars, apparently preferring them to any other food. These are the cuckoos, the yellow-billed (*Coccyzus americanus*) and the black-billed (*C. erythrophthalmus*). For years it has been a matter of common observation that these birds feed largely on caterpillars, but, until a number of stomachs had been examined, it was not known how great a proportion of their food is made up of these harmful insects. The examinations indicated that caterpillars of various species, including some of the most destructive, constitute more than 48 per cent of their food. One stomach contained at least 250 tent caterpillars, probably a whole colony, in the young stage. In another 217 heads of the fall webworm (*Hyphantria cunea*) were counted, and this probably fell far short of the real number, as these larvæ are very small, and in many instances nothing but jaws remained undigested. In the stomachs of 155 cuckoos taken in various parts of the country were found 2,771 caterpillars of various species, or an average of 18 to each stomach. When we consider that a caterpillar is so soft and easily digested that soon after being swallowed it has entirely passed from the stomach, it is evident that in one day far more than this number (18) must have been eaten by the average bird. Many caterpillars are protected from the attacks of birds and parasitic insects by a covering of hair, and hairy caterpillars are only rarely eaten by most birds. Cuckoos, however, seem to prefer them to the smooth kind, and apparently eat them whenever they can be found. Caterpillar hairs are often stiff, bristly, and sharp at the end, like minute thorns, and it frequently happens that when a cuckoo's stomach is opened and emptied it is found to be completely furred on the inside by hairs which have pierced the inner lining and become fast. Cuckoos eat many noxious insects besides caterpillars, such as beetles, bugs, and grasshoppers. Unfortunately, they are naturally rather shy birds, preferring the edges of woodland and groves to the more open cultivated grounds and orchards. If, however, they are unmolested, they soon gain confidence, and in many cases frequent shade trees about houses and lawns, or even in the very heart of the city.

BALTIMORE ORIOLE.

The Baltimore oriole or golden robin (*Icterus galbula*) also feeds largely on caterpillars, which amount to 34 per cent of its summer food. When nesting, the oriole may be seen searching among the outer twigs of trees, examining every leaf in quest of its favorite food. In addition to caterpillars, it destroys many noxious beetles and plant and bark lice. But its reputation is not unblemished. Some complaint has been made against it by fruit growers, and John Burroughs accuses it of destroying grapes. However, its peculations of this character are probably not very great, for in an examination of more than 100 stomachs very little fruit was found, and that chiefly of wild varieties, while there was an entire absence of any remains indicating grapes.

WARBLERS.

The family of warblers is of wide distribution and comprises species that are usually small and brilliantly colored. These differ greatly among themselves in habits, some remaining in the deepest shades of the forest, while others frequent groves, orchards, shrubbery, and gardens. Some seek their food by running over the bark of trees like woodpeckers or chickadees; others are terrestrial; but the great majority live on the insects which they find upon the leaves of trees. While definite data are wanting as to the food of these birds, field observation indicates that it consists largely of small caterpillars and other insects that feed on the leaves of fruit and forest trees. Although warblers are, individually, small, their numbers are great, and the quantity of insects they destroy in the aggregate must be large. A single observation will illustrate the character of their work. In the month of May, 1900, when the apple trees had just expanded rosettes of small leaves and flower buds, a multitude of warblers of several species were seen going through an orchard examining these rosettes, and apparently pecking something from each. An investigation of the trees not yet reached by the warblers showed that each rosette contained from one to a dozen large plant lice, while a similar investigation of the trees explored by the birds revealed few of these insects.

VIREOS.

The vireos are similar to the warblers in habits. Several species commonly nest in the orchards and about the buildings, obtain their food from foliage, and so destroy many insects harmful to fruit trees.

FOOD OF THE YOUNG BIRDS.

All these species do good service to the orchard when rearing their young. Our small birds, even those that, when adult, feed on fruit or seeds, rear their young on insects. Nestlings can not digest hard substances, such as beetles or hard seeds, so their parents select for them

soft-bodied insects like caterpillars and other larvæ, young grasshoppers, and spiders. Stomach examination shows that they are fed on caterpillars or spiders almost exclusively during the first week of their existence, after which the diet is gradually changed and becomes more varied.

BIRDS OF PREY.

When fruit trees are young, and more especially when they are in the nursery rows, they are subject in winter to attacks from various species of mice and rabbits, which gnaw the bark from the trunks, completely girdling the trees, and thus ruining them. As a case in point, may be mentioned a single small nursery a few acres in extent in Iowa, in which more than 3,000 trees had been girdled by rabbits in a single winter—one of several instances of equal damage that occurred in the same town. In a nursery of less than 5 acres, situated in Maryland, only a few miles from Washington, 2,000 out of about 4,000 apple trees were girdled and ruined by rabbits within two months. It is very significant that the nursery was near farm buildings where the wild enemies of the rabbits did not dare to come, while a newly set orchard at a distant part of the farm, and close by woods and thickets, was hardly touched.

Field mice and other small rodents are represented in the United States by numerous species, all of which may do mischief to young trees in winter, and most of which are doing some mischief at all seasons. Rabbits, as a rule, are not so numerous, but their larger size and fondness for young fruit trees makes their destructiveness fully as great as that of the smaller rodents, and, in fact, much greater in some sections where they are particularly abundant. But there is a group of birds which seems to be especially adapted to prey on these harmful rodents and hold their numbers within reasonable bounds; although it often happens that through the shortsightedness of man this wise arrangement is disturbed.

This group comprises the hawks and owls, of which about 73 important species and subspecies are found in the United States. Dr. A. K. Fisher has investigated[1] the diet of these birds, and has shown that the great bulk of their food consists of injurious rodents. After an examination of some 2,700 stomachs, only 6 of the 73 species and subspecies are classed as in the main harmful; the testimony of stomach examination is overwhelmingly in favor of the majority of the species. Mice, rats, rabbits, gophers, and ground squirrels constitute the chief food of most of the larger species, while many harmful insects are destroyed by the smaller ones. These birds at times feed on smaller insectivorous birds and poultry, but mice and other rodents are by far the commonest food of most species.

[1] Bulletin 3, Div. Ornith. and Mamm., Dept. Agr., 1893.

Hawks and owls hold the same relation to rabbits and mice that the smaller birds hold to the insect enemies of the orchard. For years they have been looked upon as harmful, but investigation has dissipated much of this error. While, as is the case with most birds, nearly all of them do some harm, the great majority are preeminently useful. Mice, rabbits, and other rodents are a constant menace to the interests of the fruit grower, and sometimes when through some combination of circumstances their numbers become superabundant, as has frequently happened in the case of field mice in Europe, their ravages are enormous. Indiscriminate slaughter of hawks and owls has often been followed by great ravages by voles and other mice. This should be sufficient to demonstrate the great utility of these birds as a check upon the undue increase of such pests.

GREAT HORNED OWL.—The great horned owl (*Bubo virginianus*), a bird well known in most parts of the country—though not often seen, owing to its retiring habits—is probably one of the most potent factors in holding in check that troublesome pest of the orchard and nursery, the common cottontail rabbit. Several years ago in a locality in eastern Massachusetts, through some unknown cause, rabbits became wonderfully abundant, and the following winter woodchoppers and others who visited the woods were surprised to see many great horned owls where in former years not more than two or three were annually observed. The presence of these birds so soon after the increase of the rabbits shows how quickly they avail themselves of an unusual supply of food, and thus restore the disturbed equilibrium. Unfortunately, it happened that at this time stuffed owls were fashionable as parlor ornaments, and taxidermists were therefore willing to pay a good price for them; so when it became known that the woods were full of owls, the natives did their best to reduce the number, and so perpetuated the rabbit scourge.

In a number of the Eastern States the rabbit is protected by law, and can be killed only during a small part of the year; but the animal is as much of a nuisance as are the various species of field mice, and the accident of its larger size only renders it capable of more mischief. To offer bounties for the destruction of hawks and owls and simultaneously protect rabbits is an anomaly of legislation which will probably puzzle and amuse future and wiser generations. The food value of the rabbit is insignificant compared with its capacity for mischief when it becomes overabundant. In the West the larger species, or jack rabbits, have many times become excessive in numbers, and "rabbit drives," in which the animals are surrounded and driven into a small inclosure, where they are killed, have grown to be of frequent occurrence. In Australia the European rabbit some years ago became so abundant as to threaten the very existence of the sheep industry over a wide expanse of territory. The common cottontail rabbit is already much

too numerous for the best economic results in many States of the Mississippi Valley, and is likely to become so in the East if the protection of the law is not removed.

MARSH HAWK.—An idea of the good work done by hawks and owls in the destruction of smaller mammals may be obtained by watching a marsh hawk (*Circus hudsonius*) foraging for its dinner. This hawk preys extensively on the mice and other small mammals that live on the ground near fences and hedgerows. It may be seen skimming along close to the surface, following a fence up one side and down the other, stopping now and then to circle around a particularly promising spot, and examining every rubbish heap or stone pile, till a chance movement in the grass catches its eye, when, in an instant, it throws up its wings, suddenly checking its flight in mid-air, and drops with outstretched talons upon its unfortunate prey. Mouse after mouse will be taken in this way, each of which is capable of doing much mischief to trees or grain.

The extent of the benefit of this work and full corroboration of its character is shown by stomach examination. Thus, in the stomachs of 45 rough-legged hawks (*Archibuteo lagopus sancti-johannis*), taken in several different States, were found 128 harmful rodents, 1 weasel, 1 shrew, 1 lizard, and 70 insects. The rodents, besides 19 which could not be determined specifically from the remains, consisted of 1 gopher, 2 rabbits, 4 house mice, 4 white-footed mice, and 98 meadow mice. No traces of birds or poultry were found in any one of the 45 stomachs.

BARN OWL.—When hawks or owls devour their prey they usually bolt it whole or in large fragments, with the bones, hair, and many of the unremoved feathers. By the action of the stomach the indigestible portions, such as bones and hair, are soon separated from the flesh and rolled up in a neat pellet, which is then disgorged. In the vicinity of their nests many such pellets are to be found; and when these are dissected the bones, and still more the teeth, show what animals the bird has been eating. In a tower of the Smithsonian Institution in Washington a pair of barn owls (*Strix pratincola*) have had their nest for several years. Dr. Fisher visited this eyrie on several occasions, and collected 675 pellets, of which he made a careful study, with the result that he identified the remains of 1,787 small mammals, mostly rodents, 36 birds, and 2 frogs. Of the mammals, there were 1,119 common meadow mice, one of the worst enemies to young fruit trees as well as to farm crops in general.

SHRIKES.

BUTCHER BIRD.—Besides hawks and owls, certain other native birds demand passing notice on account of the services they render by destroying mice. These are the shrikes, birds with many peculiar characteristics, whose food habits have been investigated by Dr. Sylvester D.

Judd.[1] One species, commonly known as the butcher bird (*Lanius borealis*), nests far to the north, but winters in the United States. It is a frequenter of orchards and open lands, where it constantly watches for its prey—mice, an occasional small bird, and what few insects it can obtain in winter. It is an inveterate enemy of the English sparrow, which it finds in parks and suburbs of cities and towns. A peculiar habit largely increases its usefulness. Its instinct for hunting is so keen that it can not refrain from taking its game whenever and wherever it can find it, and as the bird frequently is not hungry at the time of capture, it spits the prey on a convenient thorn, sharp twig, or barb of a wire fence. It was formerly supposed that the provisions thus saved were for future use; but although some may be subsequently eaten, most of them are left to dry up or decay.

LOGGERHEAD SHRIKE.—The loggerhead shrike (*Lanius ludovicianus*) is more southern in distribution. Its habits are similar to those of the butcher bird, but as it is with us during the summer, it captures more insects and fewer birds and mice. As it rears its young here, however, and so has occasion to use more food, it is probably fully as beneficial as the other species. Shrikes kill small birds, and to that extent do harm, but they seem to prefer mice when these can be obtained.

BIRDS HARMFUL TO ORCHARDS.

The other side of the subject under consideration remains to be shown. The injurious habits of a few birds have already been mentioned. In the case of the shrikes, the destruction of small birds is likely to be detrimental, as small birds are generally valuable aids to the cultivator; but the injury done in this indirect way is more than counterbalanced by the destruction of mice and insects, which form the great bulk of the shrike's food. Sometimes the damage is more direct. A few birds feed in winter and spring on buds of trees, both in forest and orchard. Birds of this habit will be briefly considered.

PURPLE FINCH AND HOUSE FINCH.

The so-called purple finch (*Carpodacus purpureus*) breeds in the northern tier of States and to the northward, west to the Dakotas, and south in the Allegheny Mountains as far as North Carolina, and winters from the southern part of its breeding range south to the Gulf States. When migrating in spring it subsists somewhat on buds of fruit and other trees, and later occasionally destroys the blossoms. The actual damage done by the Eastern purple finch seems trifling, but in the case of its Western relative, the house finch, or linnet (*C. mexicanus frontalis*), the matter is much more serious. This closely related bird does much harm, especially in California, by destroying the flower buds of peach, apricot, almond, and other trees. In many cases serious

[1] Bulletin 9, Biol. Surv., Dept. Agr., 1898.

injury has been done in this way, and much expense entailed, as the birds are wonderfully abundant in that section of the country.

ROBIN.

The robin (*Merula migratoria*) has often brought itself into unenviable notoriety by its depredations upon small fruits. Many complaints have been received from growers of fruit, especially those who raise but a small amount. Sometimes people who grow a few choice cherries do not get even a sample of the fruit, and those who raise fine strawberries for family use sometimes secure only a few boxes, while the robins take most of the crop. On the other hand, thousands of fruit raisers in various parts of the country are never troubled by robins, although these birds may be just as abundant in their vicinity as elsewhere. The probable explanation of this is not far to seek. An examination of the stomachs of 500 robins, collected in various parts of the country, shows that cultivated fruit forms but a moderate percentage (less than 8 per cent) of their diet; and that practically all of this is eaten in June and July; while wild fruits, of which 42 varieties have been identified, constitute more than 43 per cent of the year's food. Investigation shows that complaints have come chiefly from two principal sources, the suburbs of large towns in the East and the prairie region of the West. Such localities lack those wild fruits which robins evidently prefer. Near cities such fruits have been destroyed, and in the prairie region they rarely grow. As soon as the prairies were settled many small fruits were planted, thus affording a supply of food to the birds, while the larger fruit trees furnished sites for their nests. As none or but few of the wild fruits were accessible, it follows naturally that the birds resorted to the available supply, that is, to the cultivated varieties. Much the same condition has been created about large cities by the substitution of cultivated for wild fruit.

CATBIRD.

In parts of the Mississippi Valley the catbird (*Galeoscoptes carolinensis*) also has become one of the pests of the small-fruit orchard. East of the Appalachian range there are so many varieties of wild fruits in forests and swamps that, as a rule, the bird confines itself to these localities and does not disturb orchard products. In the prairie region, however, it is different. Before that part of the country was settled the bird was confined to the narrow belts of woods and shrubs along streams, where it found agreeable nesting sites and suitable food. When civilization transformed the prairies into farms, gardens, orchards, and vineyards, a new field was opened to the catbird as well as to other species. The fruit trees and vines not only furnished secure nesting places, but also afforded a new and abundant source of food. It is probable that this resulted in a decided increase in the numbers of the birds, which, depending largely on domestic fruit for their food,

soon became a nuisance. These conclusions, as has been suggested in several recent considerations of this subject, point to the planting of wild fruit about gardens and lawns as a protection to the cultivated varieties. Many of the wild fruit shrubs are ornamental, either in flower, as the shadbush (*Amelanchier*), or in fruit, as the mountain ash (*Sorbus*).

CEDAR WAXWING.

The cherry bird or cedar waxwing (*Ampelis cedrorum*) occurs over the greater part of the United States and is known everywhere by its fondness for cherries and other small fruits. Like the robin and catbird, however, it eats far more wild than cultivated fruit. Complaints against it have been chiefly on account of cherry eating, but its depredations are mostly confined to the early ripening varieties of cherries. By the time the later kinds ripen other fruits have also become abundant, and the bird's attention is probably diverted.

Besides eating fruit, the robin, catbird, and waxwing destroy many harmful insects, and, where not too numerous, probably do much more good than harm. All three species are very abundant in New England, but are seldom molested. The cherry bird is the only one of which serious complaint is made, and that simply on the score of stealing early cherries, while the robin is regarded almost as sacred.

CAUSE OF HARM BY BIRDS.

A careful examination of the circumstances in which birds have done harm leads to the belief that the damage is usually caused by an abnormal abundance of a species within a limited territory. In such cases so great is the demand for food that the natural supply is exhausted and the birds attack some of the products of garden or orchard.

Economically considered, birds are simply natural forces, and it should be our purpose to ascertain how they may be turned to our greatest advantage. The best economic conditions are probably fulfilled when birds are numerous as species and moderately abundant as individuals. Under such conditions there will be a demand for food of many kinds, without excessive demand for any one kind. The most desirable status would seem to be such a relation of numbers and species between birds and insects that the birds would find plenty of food without preying on useful products, while the insects would be held in such check that they would neither increase to a harmful extent nor be completely exterminated. The proper course to pursue, apparently, is to study the food habits of both birds and insects, to favor the increase of species which seem best adapted to preserve the proper balance, and to reduce the numbers of those that prey too greatly on the products of orchard or farm.

Issued November 11, 1907.

U. S. DEPARTMENT OF AGRICULTURE

BIOLOGICAL SURVEY—BULLETIN No. 30

C. HART MERRIAM, *Chief*

BIRDS OF CALIFORNIA

IN RELATION TO THE FRUIT INDUSTRY

PART I

By F. E. L. BEAL

Assistant, Biological Survey

WASHINGTON

GOVERNMENT PRINTING OFFICE

1907

Issued November 11, 1907.

U. S. DEPARTMENT OF AGRICULTURE

BIOLOGICAL SURVEY—BULLETIN No. 30

C. HART MERRIAM, *Chief*

BIRDS OF CALIFORNIA

IN RELATION TO THE FRUIT INDUSTRY

PART I

By F. E. L. BEAL

Assistant, Biological Survey

WASHINGTON

GOVERNMENT PRINTING OFFICE

1907

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Biological Survey,
Washington, D. C., July 27, 1907.

Sir: I have the honor to transmit herewith as Bulletin No. 30 of the Biological Survey, Part I of a report on the Birds of California in Relation to the Fruit Industry, by F. E. L. Beal. Fruit raising in California is a great and growing industry, and the relation birds bear to it is important. The investigations embodied in the present report were undertaken with a view to the accurate determination of the economic status of every species of California bird that inhabits orchards, in order that it may be possible for the fruit raiser to discriminate between friends and foes; and for the added purpose of suggesting remedial measures for the protection of fruit from destructive species. As expected, the strictly insectivorous birds prove to be almost wholly beneficial, by far the greater percentage of the insects eaten by them being injurious kinds. They are hence allies of the orchardist and their presence in and near orchards should be encouraged in every way. Of the species addicted to fruit eating, not one was found to make its diet wholly, or even chiefly, of fruit; and the fruit eaters, with possibly the exception of the house finch, are found to feed upon weed seeds and noxious insects to such an extent as to fully offset their destructive propensities.

Respectfully,

C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

BIRDS OF CALIFORNIA IN RELATION TO THE FRUIT INDUSTRY—PART I.

INTRODUCTION.

In response to numerous complaints from fruit growers concerning depredations by birds in orchards and vineyards in the Pacific coast region, investigation of the subject was undertaken by the Biological Survey several years ago. In conducting this investigation the writer spent about nineteen months in California, including the fruit seasons of 1901, 1903, and 1906, during which time he visited the most important fruit-growing regions of the State, inspected hundreds of orchards, and interviewed many fruit growers. Kindness and courtesy were everywhere met with, and every facility was extended by orchardists for the acquisition of information, even to a suspension of the customary rules with regard to trespass and shooting on private grounds. In addition to the knowledge gained by field observations, stomachs of all the species of Pacific coast birds economically valuable have been collected, examined, and their contents recorded.

When depredations are so widespread and involve so many different species of birds, a thorough knowledge of the nature and extent of the damage done and of the attending circumstances is of great importance. Next in importance is a knowledge of the conditions that obtain in fruit-growing regions where depredations by birds do not occur. This information should enable the fruit grower to adjust conditions in his own case so as to mitigate if not wholly prevent the evil.

In the following pages much stress is laid on the nature of the yearly or seasonal food of some of the more important species of birds, since it often happens that certain birds are more or less harmful to a particular crop of fruit, and yet the year through, all things considered, do more good than harm. It must not be forgotten in this connection that there are very few birds whose habits are wholly beneficial. Most of them are neither wholly beneficial nor wholly injurious. They are beneficial at some seasons and injurious at others. In some localities they are deservedly praised for benefits conferred; in others the same species are condemned for destructive

habits. With the evidence all in, it is usually possible for the farmer to properly estimate the status of any given species with reference to his own farm and his own interests and to adopt measures accordingly.

It can not be too thoroughly insisted that sound public policy everywhere forbids the destruction of birds on a large scale for the purpose of protecting orchard fruits. Wholesale slaughter of birds in the supposed interest of the orchardist is fortunately rare and often proceeds from a mistaken idea of their economic relations. When it is understood that the damage by a certain species is local and exceptional, that the birds in question are on the whole beneficial and that their destruction will be a loss to the State, the farmer and the orchardist are usually willing to adopt less drastic measures in defense of their crops and to spare the birds for the sake of the general weal.

STATUS OF BIRDS IN NEWLY SETTLED REGIONS.

When a new country is settled, large areas are plowed and brought under cultivation. In the process great numbers of native shrubs, weeds, and grasses are destroyed, and various new and exotic plants and trees are substituted. Coincident with this change in the vegetable life, and as a necessary consequence of it, great changes in the conditions and distribution of animal life take place. Some species are restricted in distribution and greatly reduced in numbers, or even exterminated, while others become more abundant and more widely dispersed. The reduction in numbers may occur from actual killing by man, from the destruction of natural breeding sites through clearing, and from a diminution of food traceable to the same cause. The results are exactly the opposite when cultivation and planting afford a more abundant supply of food, greater facilities for breeding, and better protection from enemies. The natural result of such conditions is a marked increase in number of the favored species, and this increase probably explains the great devastation of crops by birds that occurred on the Atlantic seaboard soon after the first settlements, and then successively in the States to the westward as these were gradually settled.

The early days of agriculture in California offer an interesting case in point. When the native grasses and weeds of the fertile valleys were destroyed to make room for grain, many species of birds, notably blackbirds and quails, were suddenly deprived of their natural subsistence and in place of it were supplied with an abundance of new and nutritious food. Naturally they preferred the cultivated grains (wheat, barley, and oats) to the wild oats (*Avena fatua*) upon which they had largely depended. Still later, when many of the

grain fields gave way to extensive orchards, which gradually crept up the hillsides and into the canyons, other species of birds began to utilize the new kinds of food and also the safe nesting sites afforded by orchard trees. Species that previously attracted little attention soon increased in numbers because of the increased food supply, additional facilities for nesting, and the protection afforded by man, who killed or drove away their natural enemies. As a result, some of them suddenly became of great economic importance, owing to their increased numbers and destructive habits.

MIGRATION OF BIRDS.

Owing to its extent and varied topography, California is rich in birds, both in species and individuals. Here altitude and topography, as well as latitude, govern climate. This fact leads to many peculiarities in distribution and complicates the study of birds in their economic and other relations. The movements of birds, too, are more complex than in the eastern part of the United States. The regular migration north in the spring and south in the fall, which is the rule over the greater part of the country, is here supplemented, in the case of many species, by a migration from the mountains, where they breed, to the valleys, where they winter. Besides the regular migrations, at times remarkable incursions of a single species take place. Such was the flight of mountain tanagers (*Piranga ludoviciana*) in the valleys in May, 1896. In several parts of California these birds appeared in immense numbers in localities where previously they had been rarely observed. Their appearance coincided nearly with the ripening of the cherry crop, to which in some places they did much damage in spite of the fact that great numbers of them were shot.

CAUSES OF DEPREDATIONS BY BIRDS.

The failure of customary food supply sometimes leads birds to forage upon crops which they do not commonly eat. This may be the explanation of the depredations of robins in the fall and winter of 1900–1901, when thousands of these birds pillaged the olive orchards in Santa Clara Valley, the region about Santa Barbara, and other parts of California. In that year it was as much as the olive growers could do to save part of their crop. Since then no case of excessive loss of olives has been reported, though occasionally some damage has been done.

The amount of damage inflicted by birds upon a crop often depends upon the surroundings. In the case of orchards in the midst of a treeless plain depredations are mostly confined to such birds as nest in them, but they may be visited and damaged by others during

migration. On the other hand, fruit grown near or in brushy canyons or on wooded hills is taken by birds that live in such places; or a stream flowing through a region of orchards may harbor in the shrubbery on its banks many birds that do not live in the orchard itself.

Hence depredations by birds may arise: (1) From the settlement of a region and consequent introduction of new crops, accompanied by a diminished supply of natural food, destruction of enemies, and a general change of natural conditions; (2) from failure of the normal food supply, causing migration in search of food, or an attack upon some product which the species does not usually eat; (3) from proximity to a particular crop, in which case the bird naturally eats that which is most available.

CONDITIONS IN CALIFORNIA COMPARED WITH THOSE IN THE EASTERN STATES.

Before proceeding to a consideration of particular birds, one point should be specially noted in connection with the subject of the relation of birds to fruit in California. Those parts of the State where fruit is grown are not so well supplied with wild fruits on which birds feed as are the fruit-growing areas of the Eastern States, or even of those farther north on the Pacific coast. While California has an abundance of wild berries which serve as food for birds, they do not commonly grow near orchards and vineyards.

In the Eastern States a plentiful supply of fruit, as acceptable to birds as the best products of the orchard or garden (perhaps more acceptable), is usually present in pastures and along roadsides, so that it is only where wild fruits are exterminated by cultivation that birds are forced to eat cultivated kinds. So abundant is wild fruit in some regions, as in the United States east of the Alleghanies, that it is safe to say that thousands of bushels of blackberries and raspberries which grow wild everywhere annually fall to the ground and rot, in spite of the fact that great quantities are gathered and eaten by man as well as by birds. The same is true of blueberries (Vaccinium) and huckleberries (Gaylussacia), which are so abundant in a wild state that in their season they appear in the markets of most of the cities and large towns, and are eaten in every country home in the region where they grow. In addition to these are several species of dogwood (Cornus), holly (Ilex), cherry (Prunus), Viburnum, and many others, all of which are freely eaten by birds.

Although many of these fruit-bearing shrubs are represented in California by related species, they usually grow in the mountains remote from fruit-growing districts. In fact, the elderberry (Sambucus), the introduced pepperberry (*Schinus molle*), and an occasional mistletoe berry are the only important uncultivated fruits

that appear in the stomachs of California orchard birds. On the other hand, in the Eastern States more than 40 species of wild fruits have been found in the stomachs of a single species—the Eastern robin. In the general dearth of wild fruits on the horticultural areas of the Pacific coast it is not surprising that when domestic fruits were first cultivated there the birds gave them a warm welcome, and the orchardist's crops suffered accordingly.

Another reason why birds attack fruit in California more than in the regions farther east is the dryness of the summers, juicy fruits proving an acceptable substitute for water. To secure enough water for their necessities California birds must often fly several miles, while in the Eastern States localities are few in which water can not be obtained within a few rods. In confirmation of the theory that in attacking fruit liquid for slaking thirst is sought by birds as much as food, it may be stated that much of the injury done to small juicy fruits in California, such as grapes and cherries, consists of simple punctures in the skin, through which apparently nothing but juice has been drawn.

PROTECTIVE MEASURES.

It would appear most desirable that some of the available fruit-bearing trees, the fruits of which are of little or no value to man, but which to birds are even more acceptable than cultivated kinds, should be freely introduced into California for the protection of the orchardist. That some of them would thrive there hardly admits of doubt. *Morus alba*, the Russian mulberry, is one of the best, the fruit having little value unless as food for birds. All fruit-eating species are fond of it. Both the red and the black mulberries are equally sought after, but are not often planted for birds alone. The paper mulberry (*Broussonetia papyrifera*) is hardy and is a favorite bird food. Several species of Prunus or cherry, including the choke cherry (*P. virginiana*), and especially its western form (*P. demissa*), the black cherry (*P. serotina*), and the bird cherry (*P. pennsylvanica*) are of great value in protecting fruit crops, birds almost invariably selecting their fruit in preference to the cultivated varieties. There are also several ornamental varieties of cherries, such as the European birdcherry (*P. avium*), *P. pendula* of Japan, and *P. sphærocarpa* of Brazil, which are hardy, the latter in warm regions only, and valuable as bird foods. Both the pepper tree, *Schinus molle*, and the elder, Sambucus, now abundant in California, are eaten by many birds, and both may be planted near orchards with the certainty that they will serve to protect them.

Another measure recommended for the protection of orchard fruit is a supply of water accessible to the birds. Drinking places for birds in every large orchard would tend to reduce the injury done to

fruit, and would serve the added purpose of attracting insectivorous birds to the locality. Birds undoubtedly select breeding places with reference to the convenience of food and water, and a constant supply of the latter attracts to the vicinity many desirable species. The insectivorous kinds would more than pay the orchardist for his trouble in their behalf by feeding upon the insects that injure his trees; while fruit-eating species, like the linnet, being able to quench their thirst with water, would not be compelled to resort to fruit for this purpose.

The writer once observed a leaky hydrant situated between two rather extensive areas of orchards. The little pool maintained by the drip of this pipe was almost constantly surrounded by birds which all the time were coming and going, so that the number that visited it each day must have been well up in the thousands. An arrangement for this purpose need be neither elaborate nor expensive, and would serve a useful purpose.

READJUSTMENT OF CONDITIONS.

In relation to the destruction of crops by birds in a comparatively newly planted region, experience everywhere shows that after a time there is a partial readjustment of conditions, so that inroads by birds become much less common or wholly cease. On the Atlantic side of the continent at the present time, with the exception of the ravages of bobolinks in the rice fields of the southeastern coast States, few if any cases are known of the annual destruction of crops by birds, while during the first half of the nineteenth century the several species of blackbirds were a constant menace to grain. Present immunity results from the fact that increased density of population has destroyed the nesting sites and reduced the numbers of some of the most noxious birds. This readjustment of conditions is likely to take place sooner or later in all cases where the balance of nature is disturbed, but in most cases the process may be hastened by the adoption of measures like the ones above mentioned.

DAMAGES BY BIRDS GENERALLY.

Study of a number of cases of serious damage by birds leads to the conclusion that as a rule such damage is due to the concentration of a great number of birds within a limited area, usually of a single species or several closely allied ones. If the birds are seed eaters, they visit the grain fields and leave ruin and destruction in their path; if fruit lovers, they seek the orchard and play havoc with the crop. Instances of this kind are the raids of bobolinks in the rice fields of

the southeastern Atlantic coast, of the blackbirds in the grain fields of the Mississippi Valley, and of the linnets in the fruit orchards of California. It is seldom that complaints are made of birds in general; one or a few species are usually the culprits, the reason for which is evident—too many individuals of the same species in one locality eating the same things. But when many species are present in normal numbers, such a variety of tastes is to be gratified that no one kind of food is unduly drawn upon.

BIRDS THAT INJURE FRUIT IN CALIFORNIA.

When a fruit grower in northern California is asked what birds are most injurious to his crops, he almost invariably mentions first the linnet, or house finch; then successively the blackbird, the oriole, the grosbeak, and the thrush. Or, if his ranch is in a narrow valley or canyon, or near wooded hills, he may place the California jay or the quail after the linnet as the next worst enemy to fruit.

The writer is pleased to be able to testify to a healthy state of feeling on the part of the great majority of California fruit growers toward the bird population. While many of them stated that they still suffered loss, none advocated measures for the extermination, or even the material decrease, of birds. The feeling seems to be practically universal that birds as a class, notwithstanding their sins, still do more good than harm. "We can't get along without the birds," was the sentiment voiced by many and really indorsed by all.

HOUSE FINCH.

(*Carpodacus mexicanus frontalis.*)

The house finch, or linnet, has been perhaps the subject of more complaint on the score of destroying fruit in California than all other species of birds together. This bird occurs on the western coast of the United States from Mexico northward to Oregon, and extends eastward to the western edge of the Mississippi Valley. Except in the mountains, it is a resident throughout most of California, but in certain parts of the northern half of the State it disappears for a few months during the winter season. In the southern half and in the warm sheltered valleys of the north it is always present. It is a hardy, vigorous species, well able to take care of itself and maintain its ground wherever it obtains a foothold. It is a prolific breeder, raising several broods in the season, and apparently has no enemy (except man) that exercises any perceptible restrictive influence upon its increase and distribution. It takes kindly to the presence of man, and utilizes his improvements for shelter and food.

DESTRUCTION OF FRUIT.

Observations in orchards show that in the fruit season the linnet is not backward in taking what it considers its share of the crop, and as it spends much of the time there, field observations alone would lead to the conclusion that fruit was its principal article of diet. Examination of the stomach contents, however, proves that such is not the case, and when we find how small is the relative percentage of fruit eaten, it seems strange that its fruit-eating proclivities should have attracted so much attention. But it must be borne in mind that the bird is wonderfully abundant, which is one of the primary conditions necessary for any species to become injurious.

Like most fringilline birds, the linnet has a strong, conical beak, with which it can cut the skin of the toughest fruit and reach the pulp. While such an instrument is very effective in attacking fruit, this is evidently not the use for which nature primarily designed it. It is customary to divide passerine birds roughly into two groups, the hard-billed and the soft-billed species, the former of which are supposed to feed on seeds while the latter subsist upon fruit and insects. From the standpoint of this classification the linnet would appear to be most emphatically a seed eater, and examination of the contents of stomachs of the species confirms the correctness of this view. Seeds of plants, mostly those of noxious weeds, constitute about seven-eighths of its food for the year, and in some months amount to much more. In view of this fact it seems strange that the house finch has acquired such a reputation for fruit eating, and it can be explained only upon the principle already laid down that in the fruit districts the bird is too numerous for the best economic interests. While each house finch eats but a small modicum of fruit, the aggregate of all that is eaten or destroyed by the species is something tremendous.

Moreover, it must be noted that not all of the fruit destroyed is eaten. Only one peck from the strong bill is necessary to break the skin of the pear, peach, or cherry, and the fruit is spoiled; the linnet by no means invariably visits the same individual fruit a second time to finish it, but often attacks a fresh one at each meal. This is proved by the large number of half-eaten fruits, either on the tree or on the ground beneath.

In large orchards, however, complaints against the linnet are fewer than formerly. Here the damage is more widely distributed and consequently less noticeable than when confined to a few trees. It is probable that the area of orcharding has increased more rapidly than the linnets, so that the proportional injury is less. At present the chief complainants are the owners of small town lots, where a few trees are grown to supply fruit for home use. As linnets are usually

more numerous in villages and suburbs than in the country, trees in gardens are often entirely stripped.

INJURY TO FRUIT BUDS.

It is a little singular that formerly most of the complaints against the linnet were that it destroyed the buds and blooms of fruit trees instead of the fruit itself. Thus in 1886 Mr. R. P. Chandler, of Riverside, San Bernardino County, wrote:

The bird which is commonly known as the linnet, or crimson house finch, has been observed to do great injury to the apricot crops of this section by feeding on the fruit buds from the time they begin to swell until the trees are in bloom. Two years ago my entire apricot crop was destroyed by the above birds, and I took the opportunity to establish the facts of the case by shooting a large number for the purpose of examination. A great many of the birds that were shot had small bits of buds, etc., stuck on their bills by the gummy substances of the fruit buds. A further examination would invariably result in finding each and every bird's stomach filled with buds.

The same year J. C. Galloway, of Tustin, Cal., stated:

The common linnet does great injury to the buds of the apricot, eating out the center and destroying all the fruit buds on the tree in many cases, usually in January and February, in this latitude.

William Proud, of Rancho Chico, Cal., accuses the linnet of eating both buds and fruit. He says:

The burion, house finch, or linnet, is by far the most pernicious bird we have to deal with in the orchard. He arrives in March and immediately commences his ravages on the buds of the cherry, peach, plum, persimmon, etc. The first cherry showing a red cheek is sampled by this most rapacious little bird. Then comes the fruit of the apricot, peach, and fig. For the latter he shows a decided partiality. When the fruit crop is exhausted he immediately turns his attention to all kinds of millets, sorghum, Egyptian corn, and other small seeds.

As showing how destructive the bird is to fruit, especially in small orchards, the following is quoted from Dr. T. S. Palmer, then at Berkeley, Alameda County, Cal.:

The crimson house finch is the only bird that does any considerable damage to fruit. As soon as the cherries begin to ripen the birds keep close watch of the trees, and if the fruit is not gathered as soon as ripe they soon dispose of a large portion of it. In our garden there are about a dozen cherry trees of various kinds, and if not very closely watched, within a week or two from the time when the fruit first begins to ripen almost every tree will be completely stripped. Of course, in a large orchard the damage would not be so noticeable, but still might be considerable. Later in the season when the cherries are gone, the finches attack the plums and pears.

F. H. Holmes, of Rio Vista, Solano County, Cal., under date of September, 1886, states:

Our worst fruit pest is the crimson house finch, which, on account of its abundance and familiarity, it is impossible to scare off. They injure mostly cherries, figs, berries, peaches, and apricots. They often only peck each fruit

a little, and then the bees and wasps take hold and finish the work. * * * Birds that destroy the earlier fruits are generally regarded as the greater nuisance, particularly to the farmer who has not a very extensive orchard. Where fruit is handled as soon as it is in the proper condition, or for an orchard of from ten to one hundred acres or more, I have never seen these birds plentiful enough to do a great amount of damage. In some parts of the State I presume they might do more.

In regard to the habit of the linnet of eating ripe fruit, Dr. A. K. Fisher says:

In this valley [Owens], both at Independence and Lone Pine, the species [the linnet] was found to be very destructive to the ripened peaches during the middle of August. Flocks of birds occurred in the orchards, and in some places hardly an example of the ripe fruit could be found which was not more or less mutilated. A number of birds shot in the peach orchards at Lone Pine had little except the pulp of this fruit in their gullets or stomachs. It was known as the 'peach bird.' [a]

Examination of linnet stomachs does not reveal any very considerable number of blossom buds, and it is probable that but little of the alleged mischief to fruit blossoms is done by this bird. Moreover, it may be stated that in most cases budding by birds does little, if any, damage. It is only in very rare instances that birds take all the buds from a tree, or even enough to cause considerable loss. On the contrary, buds are usually superabundant, and budding, whether by birds or by man, is frequently beneficial, relieving the trees from excessive bearing and markedly improving both size and quality of fruit.

THE LINNET NATURALLY A SEED EATER.

Before the settlement of the Pacific coast region it is evident that the linnet must have subsisted almost entirely upon the seeds of plants growing wild in the valleys and canyons. With the advent of civilization two new articles of food were presented—grain and fruit. It would seem natural for the linnet, especially equipped as the bird is to extract the kernel of seeds, to have chosen the former, as did the blackbirds, doves, and some other species; but for some reason best known to itself it selected fruit. How much the character of the food had to do with the bird's choice it is impossible to say, but it is probable that attendant conditions greatly influenced the result. Grain is grown on large, open areas, with few or no trees to afford nesting sites, while orchards offer every inducement to linnets as a permanent residence. Moreover, much of the fruit-growing section of the State is divided into small holdings, each with a dwelling with accompanying barns, sheds, and other buildings that afford ideal homes for these birds. Having thus chosen the orchard

[a] North American Fauna No. 7, U. S. Dept. of Agric., p. 80, 1893.

Fig. 1.

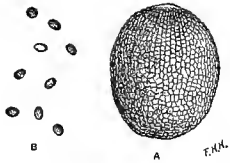


Fig. 2.

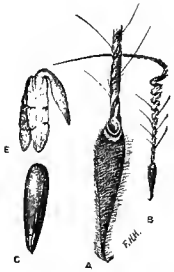


Fig. 3.

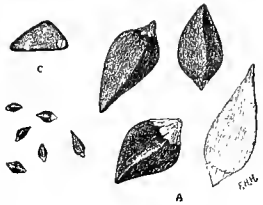


Fig. 4.

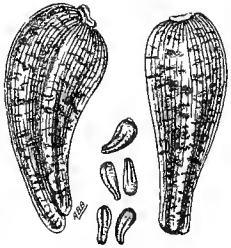


Fig. 5.

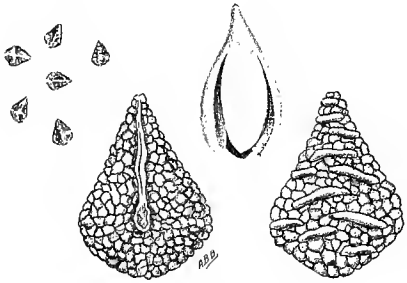


Fig. 6.

Fig. 7.

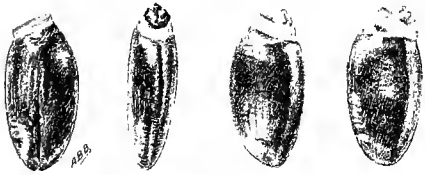


Fig. 8.

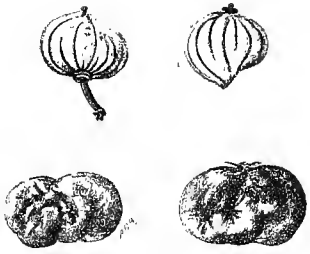


Fig. 9.

SEEDS OF COMMON WEEDS EATEN BY THE LINNET.

Fig. 1.—Napa thistle (*Centaurea melitensis*). Fig. 2.—Black mustard (*Brassica nigra*). Fig. 3.—Alfilaria (*Erodium cicutarium*). Fig. 4.—Knotweed (*Polygonum aviculare*). Fig. 5.—Tarweed (*Madia sativa*). Fig. 6.—Burweed (*Amsinckia tessalata*). Fig. 7.—Turkey mullen (*Eremocarpus setigerus*). Fig. 8.—Milk thistle (*Mariana mariniana*). Fig. 9.—Poison oak (*Rhus diversiloba*).

for its home it was only a matter of course that the bird should select as its secondary food the nearest available source of supply, namely, fruit. For seeds, which are to be regarded as the linnet's natural food, grow about the borders of orchards and by roadsides, and hence are readily obtained.

Although the great bulk of fringilline birds normally subsist principally upon seeds, at certain times, notably in the breeding season, they eat a considerable quantity of animal food, mostly insects. Moreover, their young while still in the nest are usually fed largely, and in some cases entirely, upon insects. Quite the contrary is true of the linnet. The adults eat only a small percentage of animal food, even in the breeding period, and feed their nestlings no more, perhaps less, than they eat themselves. In this respect the linnet is probably unique in its family. Such animal food as the bird does eat, however, is much to its credit. Plant-lice (Aphidæ), especially the woolly species, constitute a large portion of this part of the linnet's food; caterpillars and a few beetles make up most of the remainder.

It is, however, as a seed eater that the linnet stands supreme. Over 86 percent of its food for the year consists of weed seeds, and it is in this field, if anywhere, that the bird redeems itself from the odium of its other misdemeanors. When the immense number of linnets in California is taken into consideration, with the added fact that each one destroys several hundred seeds daily, most of which are potential weeds, it must be conceded that the bird renders a valuable service to agriculture, for the sum total of weeds so destroyed is enormous.

FOOD.

In the laboratory investigation of the food of the linnet 1,206 stomachs were examined, including 46 of nestlings. All were from California, and from points fairly well distributed over the State, with the exception of the northern quarter. The greater number were from the fruit-growing sections, so that the western coast region is better represented than the part east of the Coast Ranges. They were distributed through the year as follows:

January	88	August	118
February	35	September	123
March	186	October	108
April	80	November	25
May	74	December	54
June	167		
July	148	Total	1,206

9379—No. 30—07——2

In the first analysis of the food components the two principal elements are found to be: Animal matter, 2.4[a] percent; vegetable matter, 97.6 percent.

Animal food.—This brings into strong relief the linnet's sins of omission. Living in a country where constant war against noxious insects is necessary, the bird takes little or no part in the contest, and in return for benefits derived from man renders but slight service in this direction.

The small portion of animal food it takes, however, consists almost wholly of insects and a large proportion of it of plant-lice (Aphididæ), which from their small size do not attract the notice of many species of birds. They appear, however, to be the favorite animal food of the linnet, and it is noticeable that a large percentage of them are the woolly species. Many of the birds when killed had their beaks smeared with the remains of woolly aphides. As these insects are notoriously harmful to many trees and other plants, any bird that destroys them is a benefactor. It is to be regretted that the linnet should not indulge to a greater extent a taste so well directed. Were 25 percent of its food made up of woolly aphides the fruit it destroys would be well paid for. The other contingent of animal matter found in the linnet's stomach consists of small caterpillars and a few beetles, chiefly weevils. Most birds that feed on plant-lice eat also the ants that are usually in attendance upon them, but the only trace of ants or of other Hymenoptera in the stomachs of linnets was one ant's jaw. Grasshoppers, the favorite food of so many birds, were represented by a mere fragment in one stomach.

Vegetable food.—The most interesting part of the food of the linnet is the vegetable portion. This naturally falls into three categories: Weed seed, which amounts to 86.2 percent of the annual food; fruit, 10.5 percent; and other miscellaneous vegetable matter, 0.9 percent.

Fruit.—Fruit is represented in stomachs taken in January by a mere trace. This was probably of no value, only ungathered fruit or perhaps belated olives. In stomachs taken in February no fruit was found, but in ensuing months it appears in small quantities, increasing irregularly until August, when a maximum of 27.4 percent was eaten. In September a trifle less was taken than in August, and after that the quantity decreases until December, in which month a little less than 2 percent was eaten. In March the fruit amounted to about 6 percent, a quantity hard to account for except on the supposition that it was waste fruit left over from the previous year. The

[a] While percentages are sometimes given in fraction, it need not be assumed that extreme accuracy is intended; such figures must be taken as only an approximation to the truth.

amount eaten in this month is somewhat surprising in view of the fact that in April less than 2 percent was consumed, and it is not until June that the percentage becomes important. It is possible that the supply of weed seed of the previous year may be exhausted by March, when the new crop has not yet ripened; so waste fruit is taken for want of something better.

It is practically impossible to identify particular kinds of fruit in a bird's stomach unless characteristic seeds or stones are present. These are rarely eaten by the linnet, which seems to prefer orchard fruit. Cherries, apricots, peaches, and prunes appear to be the favorites. This choice arises, no doubt, from the character of its beak already described. While thrushes and other 'soft billed' birds prefer the smaller kinds commonly known as berries, which can be swallowed whole, the linnet attacks the larger kinds, which yield readily to its powerful beak. Linnets are particularly fond of small pears, like the Seckel, and often attack them even when they are hard, a fortnight or more before ripe. If undisturbed they will eat every one on a tree, leaving the core attached to dry and blacken in the sun.

A few strawberries and fewer blackberries or raspberries were the only cultivated small fruits that could be identified in the stomachs of linnets. A number of birds from the southern part of the State had fed freely on figs, identified by their seeds.

If the bird preferred an exclusive diet of fruit, there is no reason why its taste should not be gratified during the greater part of the year. When cherries are ripe in California linnets need eat nothing else. The cherry crop would be ample for all their wants, though perhaps not much would be left for marketing. The record, however, shows that in June, which is practically cherry month in the central part of the State, less than one-seventh of the linnet's food consists of fruit. Apricots are ripe in many parts of the State before the month closes, so that lack of fruit can not be urged as a reason why the bird should subsist so largely upon weed seed. In July apricots, peaches, and early figs are available, but still the linnet eats them only to the extent of one-fifth of its diet, and even in August and September, the months of maximum consumption, fruit constitutes only a little more than one-fourth of the food.

Weed seeds.—The greater portion of the linnet's food, as already stated, consists of the seeds of weeds, the most important of which are those of the Napa thistle, black mustard, Alfilaria, knotweed, and turkey mullen (see Pl. II, figs. 1, 2, 3, 4, 7), the total consumption of which for the year is 86.2 percent. This record is not excelled by that of any other bird studied, with the possible exception of the tree sparrow (*Spizella monticola*), whose food, however, consists largely of grass seed, much of which is useful. As there is an unaccountable

increase in the fruit eaten in March, so there is an unexplained decrease in the consumption of weed seed during that month. With that exception, the amount taken in each month decreases in a fairly regular series from a maximum of 99.8 percent in January to a minimum of 64 in August. From this month the quantity of seed in the stomachs increases steadily to December, when the record ends with 97.9 percent.

It seems probable that such a constant and persistent eater of weed seed would also eat considerable grain. Stomach records show that wheat was identified in one stomach, oats in three, and something very like the skin from kernels of corn in five. In this connection it can be said that if the linnet does not eat grain it certainly is not for want of opportunity. It is evident then that weed seed is taken by the linnet simply because it likes it.

SUMMARY.

It is natural to conclude that the food most frequently found in a bird's stomach is the kind preferred. Applying this test to the linnet we find that of the total 1,206 stomachs examined, 1,133, or 94 percent of all, held weed seed, and that 807, or nearly 67 percent of the whole, contained no other food. On the other hand, fruit was found in 297 stomachs, or 24 percent of the whole number, but only 38, or 3 percent of all, were entirely filled with it. In other words, there were only 63 stomachs that did not contain weed seed, while 909 contained no fruit.

The miscellaneous portions of the linnet's vegetable food amount to only about nine-tenths of 1 percent of the food of the year, and all was found in 28 stomachs. Stamens and other parts of flowers were found in 14 stomachs only, which does not indicate that the injury to fruit buds by the linnet is serious. One stomach contained a small leaf gall. Ten stomachs held matter denominated as rubbish, consisting of bits of dead leaves, rotten wood, etc., evidently swallowed unintentionally with other food.

From the foregoing it appears that, contrary to the statements and beliefs of many, the linnet is not a constant and persistent devourer of fruit. Examination of the contents of many stomachs shows that fruit is far from being its principal article of diet, and it is probable that what is taken is eaten for the sake of variety or for the juice. A far greater quantity of fruit is eaten by the cherry bird (*Ampelis cedrorum*) and by the robin (*Merula migratoria*), both of which occur in California.

PROTECTION OF FRUIT FROM LINNETS.

In the case of both these birds, however, the greater part of the fruit eaten consists of wild species, and this fact suggests a method

by which the California fruit grower may protect his orchards from the attack of the linnet—namely, by planting around orchards shrubs and trees the fruit of which will serve to attract birds away from the marketable kinds. There are many fruit-bearing shrubs and trees whose products, while worthless to man, are likely to prove more attractive to linnets than are the orchard fruits. That linnets will eat wild fruit appears from the fact that elderberries (Sambucus) were found in 49 stomachs, and their apparent partiality for cultivated fruits is readily explained by the fact that usually they are the only kinds obtainable.

FOOD OF YOUNG LINNETS.

Of the 1,206 stomachs of linnets included in this investigation, 46 were those of young birds taken from the nest. The young vary in age from birds 2 days old to those nearly ready to fly. In order to ascertain the exact difference, if any, between the food of the nestlings and that of the adults, the contents of these 46 stomachs were tabulated by themselves and the percentages of the various items of food calculated. The results show 2.4 percent of animal food to 97.6 of vegetable. The animal food consists mostly of the larvæ of a minute beetle which lives on decayed fruit, with a few plant-lice and one small fragment of a grasshopper, the only one found in any of the stomachs. The vegetable food consists entirely of weed seed, the most important of which are the following: Sunflower, bur weed, milk thistle, and poison oak. (See Pl. II, figs. 6, 8, 9.)

No fact connected with the food habits of the linnet is more surprising than this. The great body of the fringilline birds, though subsisting largely and in most cases almost entirely upon vegetable food in adult life, feed their young in the early stage of existence almost exclusively upon insects or other animal food, and begin to give them vegetable food only when nearly ready to leave the nest. It is doubtful if there is an exception to this rule so pronounced as the linnet. As calculated, the nestlings ate actually less animal food than their parents, but the difference is so small that it may be accidental.

ECONOMIC PLACE OF THE LINNET.

Admitting, as we must, that the orchardist has just grounds of complaint against the linnet on account of depredations upon fruit, the bird's claim to favorable consideration must rest upon its valuable services as a consumer of weed seed and upon its esthetic value. It is trim and pretty, has a sweet song, and in many ways is a pleasing adjunct of rural life—in fact, many Californians believe that the linnet, in spite of its sins of commission and omission, should be

protected. That the complete extermination of the species, even if possible, is not desirable will be readily allowed, but that a reduction of its present numbers would be for the general welfare can not reasonably be denied. Were it possible to destroy half the linnets in the fruit-growing sections of the State, there is no doubt that most of the complaints against the species would cease. As it is, the fruit grower must protect himself by such devices as are suggested by local conditions, and bear in mind that, while as an individual he may suffer, the bird, on the whole, is doing the State good service.

LIST OF SEEDS FOUND IN STOMACHS OF LINNETS.

Following is a list of identified seeds, with the number of stomachs in which each kind was found. The same kinds of seeds were of course contained in many more stomachs, but were so finely ground up as to be unidentifiable. It is not unlikely that in identifying the seeds specifically errors have been made, but it is believed that few, if any, of the generic identifications are erroneous. A few seeds were found which have not yet been identified.

Sedge (*Carex* sp.)	21
Sorrel (*Rumex acetosella*)	3
Knotweed (*Polygonum aviculare*). (Pl. II, fig. 4)	128
Catchfly (*Silene* sp.)	51
Chickweed (*Stellaria media*)	21
Spurry (*Spergula arvensis*)	14
Amaranth (*Amaranthus retroflexus* et al.)	108
Calandrinia (*Calandrinia menziesi*)	2
Miner's lettuce (*Montia perfoliata*)	11
Wild turnip (*Brassica campestris*)	13
Black mustard (*Brassica nigra*). (Pl. II, fig. 2)	83
Wild radish (*Raphanus sativus*)	108
Geranium (*Geranium dissectum*)	3
Alfilaria (*Erodium moschatum*)	392
Alfilaria (*Erodium cicutarium*). (Pl. II, fig. 3)	
Yellow sorrel (*Oxalis corniculata*)	1
Turkey mullen (*Eremocarpus setigerus*). (Pl. II, fig. 7)	117
Poison oak (*Rhus diversiloba*). (Pl. II, fig. 9)	1
Burweed (*Amsinckia tessellata*). (Pl. II, fig. 6)	3
Nightshade (*Solanum nigrum*)	4
Western ragweed (*Ambrosia psilostachya*)	3
Sunflower (*Helianthus* sp.)	5
Mayweed (*Anthemis cotula*)	1
Groundsel (*Senecio vulgaris*)	21
Lesser tarweed (*Deinandra fasciculata*)	1
Tarweed (*Madia sativa*). (Pl. II, fig. 5)	5
Milk thistle (*Mariana mariniana*). (Pl. II, fig. 8)	3
Napa thistle (*Centaurea melitensis*). (Pl. II, fig. 1)	60

The following table shows the percentages of the various items of food of the linnet for each month of the year:

Table of percentage of food of the linnet for each month in year.

Month.	Number of stomachs examined.	Animal food eaten.	Vegetable food eaten.			
			Weed seed.	Fruit.	Miscellaneous.	Total vegetable food.
		Percent.	*Percent.*	*Percent.*	*Percent.*	*Percent.*
January	88	0.0	99.8	0.2	0.0	100.0
February	35	2.9	97.1	0.0	0.0	97.1
March	186	1.0	89.5	5.8	3.6	99.0
April	80	5.8	92.5	1.7	0.0	94.2
May	74	6.3	88.9	4.8	0.0	93.7
June	167	3.9	81.6	13.4	1.2	96.1
July	148	2.2	76.5	19.7	1.5	97.8
August	118	7.1	64.0	27.4	1.5	92.9
September	123	0.1	71.6	26.7	1.6	99.9
October	108	0.0	83.5	15.6	0.9	100.0
November	25	0.0	91.7	8.3	0.0	100.0
December	54	0.0	97.8	1.8	0.4	100.0
Total	1,206					
Average		2.4	86.2	10.4	0.9	97.5

WESTERN TANAGER.

(*Piranga ludoviciana.*)

The western tanager, like the robin, occasionally becomes a nuisance in the orchard. It breeds in the mountainous regions of California and northward, and as a rule is not common in the fruit-growing sections.

DAMAGE TO CHERRY CROP.

There are, however, times during migration when it fairly swarms in some of the fruit-raising regions, and unfortunately this sometimes happens just at the time when the cherry crop is ripening. The bird is a late breeder and does not seem to care to get to its nesting ground before the last of June or early July. It is thus enabled to begin in the southern part of the State when cherries are ripening there, and leisurely follow the ripening fruit northward. The year 1896 witnessed an incursion of these tanagers, when they swarmed over much of the State and destroyed a large part of the cherry crop.

Probably the best account of this occurrence is that of W. O. Emerson (published in the Condor, Vol. V, 1903, p. 64). Mr. Emerson says:

One of the most wonderful occurrences of the movements of birds in the season of migration which ever came under my notice, took place at Hayward during May, 1896, when countless numbers of *Piranga ludoviciana*, or Louisiana tanagers, began to make their appearance between May 12 and 14. From the 18th to the 22d they were to be seen in endless numbers, moving off through the hills and canyons to their summer breeding range in the mountains. This continued till the 28th, and by June 1 only here and there a straggling member of

the flock was to be seen. They were first found feeding on early cherries, in an orchard situated along the steep bank of a creek, on the edge of rolling hills, well covered with a thick growth of live oaks, which faced the orchard on the east. To this thick cover they would fly, after filling themselves with cherries, and rest till it was time to eat again. This they would keep up from daylight to dark, coming and going singly all day, without any noise whatever being heard.

Two men were kept busy shooting them as fast as they came into the trees which lay on the side next to the oak-covered hills. * * * After the first week, I found on going here (May 17), that dozens on dozens of the birds were lying about. * * * Tanagers lay about everywhere, and no doubt many must have flown off to die in the bushes or on the hillsides. * * * I noticed one fact of the restriction of the tanagers to the orchards along the hill edges. None were found, so to speak, in the larger orchards about the town of Hayward. * * * Mr. H. A. Gaylord, of Pasadena, Cal., in a letter under date of June 16, 1896, states that "they were seen singly from April 23 to May 1. From this date up to May 5 their numbers were greatly increased, and by May 5 there was an unusually large number of them. Then for about ten days, until May 16, the great wave of migration was at its height. Tanagers were seen everywhere, and noticed by everyone. After May 20 they decreased in numbers, and by May 26 the last ones had left the valley." * * * He also says: "The damage done to cherries in one orchard was so great that the sales of the fruit which was left, did not balance the bills for poison and ammunition. The tanagers lay all over the orchard, and were, so to speak, 'corded up' by hundreds under the trees."

There must have been thousands of tanagers destroyed all through the path of their movement along the State, as they worked their way to the breeding grounds.

Here are two accounts of this great flight of tanagers—one from Pasadena, the other from Hayward, 330 miles farther north as the bird flies. The time taken by the tanagers in traversing this distance was only eight days, so it would appear that individual birds did not spend much time in the same orchard. Such sporadic flights are hard to account for. The tanagers are in California every year, and every year they migrate to their nesting grounds in spring and return in fall, but only at long intervals do they swarm in such prodigious numbers. Evidently the migration ordinarily takes place along the mountains where the birds are not noticed. It is possible that in some years the mountain region lacks the requisite food, and so the migrating birds are obliged to descend into the valleys. This would seem to be the most plausible explanation of the occurrence—that is, that the usual line of migration is along the Sierra Nevada, but some years, owing to scarcity of food, or other cause, the flight is forced farther west into the Coast Ranges, where the birds find the ripening cherries. The damage done by this species, however, is not confined exclusively to the rare occasions when they appear in such extraordinary numbers. R. H. Carr, of Redlands, southern California, wrote us in June, 1899:

Without examining any stomachs it is easy to report the value of the Louisiana tanager to the fruit growers near here. In the city they seem to keep

almost entirely on the Grevillea trees, sipping the sweet liquid that exudes from the blossoms. But the Andrews Brothers, whose cherry and apple ranch is in the upper Yucaipe Valley, report that the tanagers destroyed about $4,000 worth of cherries, being almost the entire crop. They used powder and shot liberally, but did not save the crop.

It is to be regretted that some of the stomachs of these tanagers were not saved, in order that the diet of the species might be ascertained with precision. The only material available for examination consists of 46 stomachs from various parts of the State, during the six months from April to September, inclusive. This number is entirely too small to afford positive data as to the regular food habits of the bird, but undoubtedly points in the right direction. Although the testimony of field observers shows that this tanager eats a good deal of fruit, analysis of the stomach contents proves that over 82 percent of the food for the six months indicated above consists of insects, and the remainder, nearly 18 percent, of fruit, with a mere trace of seeds of a conifer.

Insect food.—The largest item of the animal food is Hymenoptera, most of which are wasps, with some ants. Altogether they amount to 56 percent of the food for the six months, and in August they reach 75 percent. (They reach 92 percent in April, but only one stomach was taken in that month, so the record is not reliable.) Hemiptera stand next in importance, with 8 percent. They are mostly stink-bugs, with a few cicadas. Beetles amount to 12 percent of the food, of which less than 1 percent are useful Carabidæ. The remainder are mostly click-beetles (Elateridæ) and the metallic wood-borers (Buprestidæ), two very harmful families. The former in the larval stage are commonly known as wireworms, and bore into and destroy or badly injure many plants. The Buprestids, while in the larval stage, are wood-borers of the worst description. Grasshoppers were eaten to the amount of 4 percent, and caterpillars to the extent of less than 2 percent.

Fruit.—The greater part of the fruit eaten appeared to be the pulp of some large kind like peaches or apricots. One stomach contained seeds of elderberries; another the seeds and stems of mulberries, and two the seeds of raspberries or blackberries. Nearly all these stomachs were collected in the mountains, away from extensive orchards, but still the birds had obtained some fruit, probably cultivated.

SUMMARY.

It is evident from the testimony that great damage from this species occurs only at rare intervals and during the spring migration. The greatest losses occurred in May, 1896, when the damage to the cherry crop in certain localities was most disastrous. As, under ordinary circumstances, the greater part of the food of this bird consists

of insects, many of them harmful, the tanager has a fair claim to consideration at the hands of the farmer and even of the orchardist.

It is probable that means may be found to prevent, at least in part, the occasional ravages of the tanager on the cherry crop. The tanager, like the robin, prefers to swallow fruit whole, and as the latter takes small wild cherries in preference to the larger, cultivated kinds when both are equally accessible, it is probable that the tanager would do the same; and it is suggested that a number of wild cherry trees planted around California orchards might prove an economical investment for the orchardist.

SWALLOWS.

Swallows are the light cavalry of the avian army—always on the move, always on the skirmish line, ever gathering stragglers from the insect camps. They furnish another instance, and perhaps the most remarkable one, of change of habit induced by civilization. In eastern United States the bank swallow and the rough-wing are the only species that adhere persistently to their original nesting sites. In the West a third species may be added to these, the violet-green swallow; but there all the swallows are somewhat less domestic than in the East. It is probable, also, that some species, notably the barn swallow, are more abundant than when the country was unsettled, owing to the increased number of nesting sites. Supposing for a moment that the country was swept bare of buildings, where could all the barn swallows find suitable places to nest? The cliff swallows might discover enough overhanging cliffs upon which to attach their mud domiciles; the white-bellied and the martin, as formerly, might nest in the hollows of trees, but there are not caves enough east of the Mississippi River to afford nesting places for one-tenth of the barn swallows. In the far West they would fare better. When the country was first settled, barn swallows must have been confined to a few rocky cliffs and caves here and there along the seashore or in mountains. Now they live wherever man has erected a structure of any kind.

As is to be inferred from the movements of these birds, their food, with some curious exceptions, consists principally of insects caught in mid-air. For this reason all the species are migratory, except in the Tropics, for the food supply fails in regions where frosts prevail. As many insects that usually do not fly, periodically 'swarm,' they are often captured by swallows at such times in great numbers. Such is the case with ants and 'white ants' (Termitidæ), which most of the time are concealed in the earth or in logs, but at certain times 'swarm' in immense numbers. Many species of beetles that live in offal and ordinarily are not accessible to birds, in case of failure of

food, migrate in great numbers, and then are preyed upon by swallows, flycatchers, and other birds. The destructive cotton boll weevil is more or less active during the late summer and early fall months, and it has been learned that the swallows, as they pass through the cotton States on their way to their southern winter quarters, catch great numbers of them on the wing and so perform an exceedingly important service. Engraver beetles (Scolytidæ) have frequently been found in the stomachs of swallows. These insects live under bark, and generally are inaccessible to birds, except woodpeckers; periodically they migrate from the tree where hatched and matured to search for fresh pastures; at such times they are unprotected and fall easy prey to any fly-catching bird. Swallows are peculiarly adapted to capturing small insects in mid-air. While their bills are weak their mouths are wide, and their long wings enable them to fly swiftly and turn quickly, so that they sweep back and forth through a swarm of insects and gather them by hundreds.

Seven species of swallows, with several subspecies, are commonly found within the limits of the United States. Their food habits vary but little. All seven species occur in California, and this number includes one, the violet-green, that does not occur in the East.

Besides the swallows whose food will be discussed in detail in the following pages, a few stomachs of the tree swallow (*Iridoprocne bicolor*), the western martin (*Progne subis hesperia*), and the bank swallow (*Riparia riparia*) have been examined, but the number is entirely too small to be used as a basis for general conclusions were it not for the fact that their contents agree in all essential points with those of the other swallows, of which a greater number were available for examination. In fact, it may be said of all the members of the swallow family that they subsist upon practically the same kind of food, with slight variation from month to month. It may be laid down as a general rule that the food of all American swallows is derived from the following orders of insects: Coleoptera, Hymenoptera, Hemiptera, and Diptera, with a few individuals from one or two other orders, and an occasional spider. So far as present investigation has shown, 90 percent of their animal food is from the four orders named above, but the relative proportion of each varies somewhat with the different species and seasons. With one notable exception [a] the swallows take so little vegetable food that it may be passed by as a negligible quantity, and much even of the little eaten is probably swallowed accidentally.

After the above statements in relation to the food of the swallows, it is perhaps unnecessary to dwell upon the great value of these birds

[a] The tree swallow of the East (*Iridoprocne bicolor*) during its southern migration freely eats the berries of the bay-berry (*Myrica carolinensis*).

as insect destroyers. They do not consume any product of husbandry, and the worst that can be said of them is that they eat some useful insects with the harmful ones, though the former are in a very decided minority. This statement, however, applies to any and all insect-eating birds. It would be just as reasonable to expect a mower or reaper to cut grain and leave the weeds standing as to suppose that from the hordes of insects around us birds will select only the ones that are injurious to man and leave untouched those that are beneficial. Then, too, a superabundance of any species of insects, even beneficial ones, would be a nuisance. The service which swallows render is to prey upon the whole insect tribe and so to reduce the flood of insect life to a lower level where it may be more easily dealt with by man.

CLIFF SWALLOW.

(*Petrochelidon lunifrons.*)

In the Eastern States the cliff swallow has practically abandoned its original nesting sites under cliffs, and now nests under the eaves of houses and other buildings. The writer has counted 80 nests beneath the eaves of 1 barn. In California the bird has taken up with the new order of things to some extent, but has not entirely abandoned its old habits. It is a migrant and remains in the State for about six months only during the breeding season, which is the time when the bird does the most good.

The following discussion of the food of the cliff swallow is based upon the examination of 123 stomachs, representing every month from April to September, inclusive.

Vegetable food.—Vegetable food to the extent of 0.32 of 1 percent was found. In most cases this was simply rubbish taken accidentally, though it includes a few small seeds.

Animal food.—Of the animal matter the largest item is Hymenoptera. These insects formed over 39 percent of the total food; most of them were bees and wasps, and small parasitic species were identified in a number of stomachs; a few were ants. Unfortunately, many parasitic insects are eaten by birds that take their prey upon the wing, such as swallows and flycatchers. The fact is to be deplored, but in most cases the percentage is not large. Perhaps the most interesting insect among Hymenoptera eaten is the common honey-bee (*Apis mellifera*). Of these, 34 were identified, all contained in 11 stomachs, in one of which were 8 individuals. All were drones—that is, males. Not a trace of a worker bee was found. In two stomachs drones constituted the whole food and in several others the principal part. It is probable that most of them were taken when the queen made her marriage flight. So far as the writer has

been informed, bee keepers do not regard the destruction of drones as injurious to the swarm. In most cases drones are superabundant and instead of contributing to the food supply they are a drain upon it, so that the destruction of some of the surplus males is a positive benefit to the colony.

Hemiptera, or bugs, stand next to Hymenoptera in importance in the food of the cliff swallow. They form a little less than 27 percent of the whole diet, and are represented by eight families, namely, assassin-bugs, leaf-bugs, squash-bug family, stink-bugs, shield-bugs, tree-hoppers, leaf-hoppers, and jumping plant-lice.[a] All of these, excepting the assassin-bugs, are injurious to plants, and some of them are pests at all times. Of these, probably the leaf-hoppers (Jassidæ) are the worst. They suck the juices of plants, particularly grasses, which they infest by millions. They are said to have but few enemies, of which birds are the most effective. It is probable that they are captured by swallows when just skimming over the surface of fields, or are snatched from the tops of grass and weeds. They were found in 27 stomachs.

Leaf-bugs (Capsidæ) are a very large family of harmful insects, which feed almost entirely upon plants. Some species of this family are pests of the worst description. Leaf-bugs were contained in 43 stomachs. The other insects of this order are more or less harmful, but were not eaten so extensively.

Beetles of all kinds aggregate a little less than 19 percent. Of these, 2 percent were useful species, such as carabids and coccinellids. The others belong to 12 different families, most of which are harmful, some very much so. Among them were a number of aquatic species. These were probably captured by the swallows when flying just above the surface of the water. The principal flights of beetles do not occur during the day, but chiefly in early evening and at night.

Flies are eaten by cliff swallows to the extent of nearly 12 percent of the food. Most of these are the species commonly known as gnats, but one stomach contained a large horsefly (Tabanidæ). The gnats have a habit of swarming afternoons and evenings, when many are probably snapped up by swallows.

The remains of dragon-flies, lace-winged flies, ephemerids, and spiders make up the rest of the food, or a little more than 3 percent. As spiders do not fly, it may be asked how they were captured by the swallows. They probably were snatched from their webs or from the tops of weeds as the birds passed. Swallows pick up substances even from the ground, as is shown by the vegetable component of their food, and by other facts to be given presently.

[a] Plant-lice and scale-insects were not present, and this may be explained from the fact that their lives are passed mostly in a wingless condition.

FOOD OF YOUNG.

Among the stomachs examined were those of 22 nestlings, varying in age from 2 days to those just ready to leave the nest. They were taken from May 30 to July 2, inclusive. In order to ascertain if important differences exist between the food of the adults and that of the young, the contents of these stomachs were tabulated separately. Comparison shows little or no difference in the quantity of vegetable matter eaten by adults and young.

The animal matter in the food of the young is precisely of the same kind as eaten by adults, but the proportions are rather different. Hymenoptera are the largest item in the food of the young as well as of the parent birds, and amount to 42 percent for the former against 39 percent for the latter. Diptera stand next in importance, with 30 percent for the young against 12 percent for the adults. As these insects are mostly soft-bodied, it is the usual custom of birds to feed a greater proportion of them to the young. Hemiptera amount to a little more than 16 percent of the nestlings' food, while the adults eat them to the extent of nearly 27 percent. Beetles are fed to the young to the amount of about 10 percent, while the parents eat them to the extent of 19 percent. This again might naturally be expected, as most beetles are hard and less easily digested than flies and some other insects, and hence are less suitable food for young birds.

From the foregoing it is evident that the food of young cliff swallows does not differ in kind from that of the adults, but is distributed among the various orders of insects in somewhat different proportions. Hymenoptera and Diptera constitute nearly three-fourths of the diet, evidently because they are soft and easily broken up and digested. Beetles and bugs appear in the stomachs less frequently. While beetles are not extensively eaten, it is worthy of note that the variety is considerable, as representatives of no fewer than 10 species were contained in the stomach of one nestling. One stomach held a few bits of eggshell, and gravel was identified in two others. One of these contained 7 good sized gravel stones; the other, pieces of glass and gravel. The supposed function of gravel in the stomachs of birds is to assist in breaking up the food. That gravel should be given young cliff swallows when not taken by the adults is remarkable. The feeding of gravel to the young has been noted in the case of other species of swallows.

WESTERN BARN SWALLOW.

(*Hirundo erythrogastra.*)

The barn swallow is rapidly learning, not only that the structures built by man afford excellent nesting sites, but that the presence of

man is a sufficient protection against enemies. This species is generally distributed over the west coast region, but it is not so common as it is in the East, probably because of the relative scarcity of nesting sites. It is not improbable, however, that the end of the present half century will see the barn swallow as common throughout the whole of the region as it is in the East.

Eighty-two stomachs of barn swallows were examined, taken from April to October, inclusive, though April was represented by only two stomachs and October by one. While a greater number would have been desirable, the close resemblance of the food to that of the eastern birds, as shown by the contents of these stomachs, gives assurance that the results are reasonably reliable.

Vegetable food.—Practically no vegetable food was found in the stomachs examined. A single unknown seed was contained in a stomach taken in September.

Insect food.—So far as these 82 stomachs show, the western barn swallow subsists entirely upon insects, and it may be added that the same is true of the eastern bird.

The largest item of food is made up of Hemiptera of various families, amounting to nearly 39 percent of the whole. None of these insects was present in the two stomachs taken in April, but in every other month they constitute a large percentage of the stomach contents, and in September, when 38 stomachs were taken, they amount to 90 percent of the food for that month. Representatives of 8 families were identified, but the principal and most important ones are the leaf-bugs (Capsidæ), which were found in 44 stomachs.

Flies are next in importance, and amount to 32 percent of the food. Most of them belong to the family of the common house fly (Muscidæ), though probably there were others too badly mangled to be identified. No long-legged crane-flies (Tipulidæ), usually commonly eaten by birds, were found.

Hymenoptera constitute 18 percent of the food. Most of them consist of wasps and wild bees, but a few stomachs contained ants. One stomach had a drone honey-bee. Several birds had eaten parasitic species of Hymenoptera; a separate account was kept of these so far as possible, but the total amount summed up to only about one-fourth of 1 percent of the whole food.

Beetles aggregate nearly 10 percent of the whole, and belong to 13 families, with no preference for any. The bird probably snatches any and all beetles which it comes across. A few of the destructive engraver beetles (Scolytidæ) were found in 3 stomachs. Dragonflies and several unidentified remains constitute the remainder of the food and amount to a little more than 1 percent.

FOOD OF YOUNG.

The stomachs of two broods of nestlings of 4 each are included in the foregoing. The contents do not differ from those of adults except that they include a small percentage of gravel. Some of them contained also fragments of eggshell; one had a piece of mother-of-pearl (nacre), and one a small splinter of bone. It is curious that these indigestible substances should be so often fed to nestlings when the parent birds seldom take them.

VIOLET-GREEN SWALLOW.

(*Tachycineta thalassina lepida.*)

The violet-green swallow does not occur east of the Great Plains. Its general habits appear to be almost identical with those of its eastern relative, the white-bellied swallow.

The natural nesting site of both species was a hollow in a tree, and the western bird still adheres to the original habit and nests in the hollows of oaks and other trees, but the white-belly has to a great extent followed the example of so many of its relatives, and has taken to holes in buildings or to boxes put up for avian use.

In its food habits the violet-green exhibits no marked peculiarities; in fact it may be said that the food of the different species of swallows differs in degree rather than in kind. Stomachs of the violet-green have been collected in every month, except June, from March to September, inclusive, but only 7 were taken earlier than July. In that month, however, and the two following months 67 were obtained, a sufficient number to give a fair idea of the food at this season.

Insect food.—Insects constituted practically the entire contents of these stomachs. No spiders were found, and the only vegetable matter was a single seed, no doubt accidental.

As with the barn swallow, the largest item is Hemiptera, or bugs. These are represented by 10 different families, of which the leaf-hoppers (Jassidæ) were the most numerous, and the leaf-bugs (Capsidæ) next. Altogether they amount to 36 percent of the food.

Diptera stand next in importance, and in this respect also the violet-green resembles the barn swallow. They constitute nearly 29 percent of the food. Neither Diptera nor Hemiptera, however, are eaten as freely by the violet-green as by the barn swallow, and the deficiency is made up by Hymenoptera.

Hymenoptera amount to 23 percent of the food, and in the month of July were mostly made up of ants. Six stomachs taken on the same day and in the same locality were entirely filled with these insects. One taken at the same place on the following day was half filled with them, and this, with the exception of 1 percent

contained in one stomach in August, is the whole story of ants in the food of the violet-green. All of the other hymenopterous food consists of wasps and wild bees. In explanation of the fact that this bird eats ants freely for a short time and then eats no more, it may be stated that much of the time they are not obtainable. It is only when the insects are on the wing while swarming that the swallows can catch them, and then, being very numerous, they are eaten freely.

Beetles collectively amount to something over 11 percent of the food of the violet-green. Of these nearly 3 percent are Carabidæ, with a few coccinellids and carrion beetles, which must be reckoned as useful insects. The rest, over 8 percent, are of several families, all of which are more or less harmful. Three stomachs, collected at the same time in Carmel Valley, are of interest. They contained respectively 42, 45, and 40 percent of scolytid or engraver-beetles. This was in the region of the Monterey pine (*Pinus radiata*), and there is no doubt that these insects prey upon those trees, and probably were taken when migrating in a swarm to fresh foraging grounds. A few moths, with some unidentified insects, make up the remainder of the animal food, a little more than 1 percent.

CALIFORNIA SHRIKE.

(*Lanius ludovicianus gambeli.*)

The California shrike is common in parts of the Pacific coast region. At the present time fence posts and telegraph lines are the vantage points from which shrikes ordinarily scan the ground for prey, and in certain parts of the valley region it is unusual to glance along a line of wire and not see one or more within a short distance. It does not seem that trees and shrubs could ever have adequately supplied the need for lookout stations which is now filled by the poles and wires.

There seems to be a mysterious sympathy between the shrike and the little sparrow hawk, or perhaps their relations are inspired by jealousy. The sparrow hawk also occupies the poles and wires as a lookout for prey, and whenever a hawk stations himself upon one of the poles, there, at no great distance, is sure to be a shrike keeping close watch upon the movements of the larger bird. When the latter moves the shrike follows, and seems to aim to keep the other continually in view. Perhaps the shrike sees in the hawk a rival and considers that his preserves are being trespassed upon, though one would think there was room enough and prey enough for both. No case of actual conflict between the two has been observed—only this constant and unremitting surveillance on the part of the shrike.

The shrike resembles a bird of prey in form of beak and, to a certain extent, in food habits. Unlike the true birds of prey, however, its feet are not provided with talons for seizing prey and holding it securely while it is being torn into pieces. Whenever the shrike captures game that must be torn apart it presses it firmly down into a forked branch where it can readily be dissected.

The habit of the shrike of storing food apparently for future consumption has often been noticed. When food is abundant surplus captures are hung on thorns, sharp twigs, or, in recent times, the barbs of wire fences until needed; but as such occasions seldom arise, nine-tenths of this stored food is wasted so far as the shrike is concerned. Various more or less plausible explanations of this habit have been offered, but the simplest and most natural seems to be that much of the time the bird hunts simply for the pleasure and excitement of the chase, and as prey is often captured when hunger has already been satisfied it is stored for future use. It is the same instinct and lust for slaughter that prompts man to kill game that he can not use. The habit seems to be manifested also in a somewhat different way by the crow and magpie, which store up bits of glass or bright metal for which they can have no possible use. In the case of the shrike, however, the habit is useful to man if not to the bird, for most of its prey consists of noxious creatures, the destruction of which is a decided benefit.

The diet of the shrike and that of the sparrow hawk are almost exactly alike. It is a curious illustration of two species standing far apart systematically but by special modification approaching each other in food habits. The sparrow hawk has all the equipment of a carnivorous bird, but owing to its diminutive size its attacks are necessarily confined to the smaller kinds of prey, largely insects. The shrike, on the other hand, is a member of a group almost purely insectivorous, but it is so large and strong and has a beak so modified that in addition to its ordinary diet of insects, it is able on occasions to capture and tear apart small birds and mammals. While at present the two birds subsist upon much the same diet it is evident that their food habits have been modified in different ways. The natural food of the hawk family as a whole is vertebrate animals, to which some of its members, including our little sparrow hawk, have added a large percentage of insects. The normal food of the shrike is insects, to which on occasions it adds the smaller species of vertebrates.

Like the birds of prey and some other birds, the shrike habitually disgorges the indigestible portions of its food after the nutritive part has been digested. The bones and hair of mice are rolled into compact pellets in the stomach and finally disgorged. From examination of these a very good idea of the shrike's food may be gained.

A shrike of the eastern subspecies was kept in confinement for some weeks by the Biological Survey and notes made in regard to its food habits. A thorny bush was placed in the cage, and whenever the bird was given food in excess of its immediate wants it impaled the surplus upon a thorn, taking great pains to press it securely down. On one occasion a dead mouse was placed in the cage; it was at once seized and forced into the fork of the bush and was then torn piecemeal and eaten. Note was taken of the time when the last bit was swallowed, and a close watch kept for further results. In an hour and a half the bones and hair of the mouse were disgorged in the form of a neat pellet. Everything digestible had been stripped from the bones. A May-beetle (Lachnosterna) was eaten and the pellet containing the remains appeared in an hour and twenty minutes. At another time a ground beetle (Calosoma) and a stink bug (Nezara) were eaten and their remains appeared in forty minutes. As both of the insects are nauseous, at least to human smell and taste, it is possible that they may have been unacceptable to the stomach of the bird, and so were rejected before digestion was complete. On another occasion a second Calosoma and a moth were given, and their remains were regurgitated in an hour and fifteen minutes. These experiments show how rapid is the process of avian digestion.

In the investigation of the food of the California shrike 124 stomachs were examined. They were collected in every month, but the greater number were taken in the warmer months.

Vegetable food.—Animal food of all kinds amounts to 97.5 percent, or so nearly the whole that it is fair to suppose that the greater part of the 2.5 percent of vegetable matter present was swallowed unintentionally—that is, when sticking to something else. All of it was contained in 9 stomachs. Fruit appeared in 2 stomachs, seeds in 2, and rubbish in 6. Of these probably only the fruit was taken as food. One stomach was filled with elderberries to the amount of 84 percent of the contents, the other with the seeds of blackberries or raspberries to the extent of 13 percent. It thus appears that the shrike sometimes eats fruit.

Animal food.—The animal portion of the shrike's food may be divided into three parts: Insects, 83 percent; spiders and a few snails, etc., 2 percent; vertebrates, 12 percent.

Insect food.—In comparing the food of eastern subspecies of shrike and the one under discussion, we find that more insects are eaten by the western one. The figures for the eastern bird are: Insects, 68 percent; spiders, 4 percent; vertebrates, 28 percent. The difference is undoubtedly due to climate, the western bird being able to find insects all the year round, while the eastern one discovers very few during the winter. Insects probably are always preferred when obtainable.

Of insects eaten by the shrike, the largest item is Orthoptera—that is, grasshoppers and crickets—which amount to nearly 43 percent of the whole food. They are eaten in every month of the year, and in August and September reach nearly 70 percent. These are the normal grasshopper months, the ones in which Eastern birds enjoy their annual grasshopper feast. Ordinary grasshoppers form the greater part of this item of food, but a good many crickets are eaten, especially the brown and striped so-called wood crickets. One group of these is particularly noticeable—a group of large soft-bodied monsters of the genus Stenopelmatus, many of which live under dead leaves, stones, and rubbish, and do not often voluntarily show themselves by the light of day. It seems strange that the shrike, a lover of open and sunshine, manages to discover these creatures. They are sometimes called 'sand-crickets,' and perhaps at times come out into the open, but the writer has never seen one except when dug from under rubbish. It is not known whether these insects are harmful or beneficial, so the shrike's consumption of them has no economic interest. It is quite the contrary, however, with regard to grasshoppers, for they are harmful in all stages of existence, and the shrike is directly beneficial to the farmer to the extent that it destroys them.

Beetles collectively are second in importance in the shrike's diet. They amount to 16 percent of the food, but of this about 7 percent are the useful ground beetles (Carabidæ) and carrion beetles (Silphidæ). The rest are mostly harmful. The presence of these last is a curious point in this connection. These insects are probably useful, and while no great number of them are consumed, it seems rather strange that they are eaten at all. The surroundings of these beetles are not pleasant, and they do not generally serve as food for birds except crows and other garbage hunters. Is it possible that the shrike finds them on the game which it has hung on twigs or thorns? They were noted in 8 of the 124 stomachs, and three species were identified. Most of the beetles eaten by the shrike are of the larger species, but it does not disdain small game, and quite a number of small leaf-beetles and weevils were among the others.

Ants and wasps amount to something more than 11 percent in the diet of the shrike. Naturally they are mostly eaten in the warmer months, and the wasps far outnumber the ants.

Moths and caterpillars are taken to the extent of somewhat more than 7 percent, and seem to be a regular though small component of the food. Unlike the wasps, the greater number of these were eaten in the colder months. One stomach was entirely filled with the remains of 15 moths, a most unusual occurrence, for adult Lepidoptera do not form a large element of the food of any bird yet investigated.

Bugs and flies are eaten occasionally. The stomachs taken in February contained a good percentage of Hemiptera, and so did those

collected in July. In one stomach remains of robber-flies (Asilidæ) were detected. This is a family of large predaceous flies, some species of which are said to prey upon honey-bees. These two orders and a few other odd insects constituted 5 percent of the food.

Spiders and several other kindred creatures form less than 2 percent of the food, but though not eaten in great numbers they appear in a good many stomachs. In one stomach was found one of those bristly and uncanny monstrosities of the order of jointed spiders (Solpugida). It is wonderful that any bird should attack one, still more that it should eat it, as it would seem to be about as palatable as a paper of pins. The lingual ribbon, or tongue, of a snail was found in one stomach, and bits of what appeared to be the limbs of small crustaceans in several. They did not amount to a noticeable percentage.

Vertebrates.—The vertebrate part of the shrike's food amounts to a little more than 12 percent, and consists of the remains of small mammals, birds, and lizards. Mammals were found in 4 stomachs, birds in 2, and lizards in 12. Neither of the birds could be identified further than that both were small song birds. Of the mammals, one was a pocket mouse (Perognathus), one a young field mouse (Microtus), and one a shrew (Sorex). The fourth mammal could not be identified, as there was little left except hair. The lizards were not recognizable either generically or specifically, as the remains consisted only of bones and scales. From an economic standpoint, lizards are useful animals, as they subsist on insects. The same is true of birds, so that in destroying birds and lizards the shrike is doing harm. Fortunately, it does not eat many birds. The destruction of the mammals is an unmixed blessing, except, perhaps, in the case of the shrew (Sorex), which is largely insectivorous. Even if all the above vertebrates were useful the score against the shrike would not be a very heavy one and would not outweigh the value of its services in destroying grasshoppers. In the writer's field experience with the shrike only one attempt to capture a vertebrate animal was observed. In this case the shrike was seen to plunge into a thicket of weeds in pursuit of a brood of tiny quail, but a few seconds later it emerged in a great hurry, closely followed by the irate cock quail. As a matter of fact, the noxious mammals eaten both by the eastern and western shrikes far outnumber the birds, and when to the former are added harmful insects the balance is very largely on the credit side.

FOOD OF YOUNG.

No nestlings of shrikes were at hand for investigation, but the stomachs of two young just out of the nest were examined. Both

were filled with beetles, ants, wasps, and crickets. In a bird so thoroughly insectivorous as the shrike it is not probable that the food of the nestlings differs essentially from that of adults.

As a feature of the landscape and as lending animation to rural scenes the shrike in California is a pronounced success, and when one sees him jauntily balancing on a telephone wire it is pleasant to reflect that in his economic relations he is as admirable as he is from the esthetic point of view.

VIREOS.

The vireos are a group of rather small tree-haunting birds of plain colors, modest habits, and sweet but unobtrusive voices. One or the other of the several species inhabits pretty much everything in the way of a tree from the monarchs of the forest down to the humblest underbrush. In thickly settled country vireos inhabit gardens, orchards, and city parks, and shade trees along the village streets. Most of them are migrants, and leave the United States in winter, but a few remain on the Pacific coast throughout the year. Their food consists largely of insects, though a little fruit and some seeds are occasionally eaten.

In the insect diet of the vireos there is one element which constitutes a bar sinister on an otherwise brilliant escutcheon. All the species investigated show a decided taste for ladybirds—that is, coccinellid beetles. No other genus of birds, nor any single species (with one possible exception), so far has been known to manifest such fondness for these useful insects. In California the destruction of ladybird beetles is perhaps a greater crime than it would be in almost any other section of the country, for here the bark scales and plant-lice upon which these beetles feed are very destructive, and every device for their extermination has been employed, even to importing several foreign species of these predatory beetles.

Time was when the devastation of the San Jose scale and several other species of scale insects threatened the fruit industry of California, and there can be no reasonable doubt that the coccinellid beetles of both the imported and native species were largely instrumental in checking the spread of these pests. It is to be remarked that these beetles are wonderfully abundant in California, probably more so than any other family. The writer found them upon corn, weeds, grass, and bushes, often where apparently there was none of their natural food. In mitigation of the vireos' habit of eating ladybirds all that can be said is that where there is such a superabundance of the insects the damage is minimized.

The writer is glad to be able to add that besides the coccinellids, vireos eat many harmful insects, among which are the black olive

scale. Here, then, is an instance where the bird eats the useful beetle and also its noxious prey. As there is nothing to indicate that the bird exercises a choice between them, we must infer that it eats both whenever it finds them. It eats the beetles and the food (scales) upon which they feed. From this point of view also it must be allowed that the harm done by the vireos in eating coccinellids is offset to some extent.

WESTERN WARBLING VIREO.

(*Vireo gilvus swainsoni.*)

One hundred and ten stomachs of the warbling vireo have been examined. They were collected during the seven months from April to October, inclusive, and though hardly as many as could be desired, they probably furnish a fair idea of the food during that portion of the year.

Vegetable food.—Insects, with a few spiders, amount to over 97 percent of the diet, leaving less than 3 percent of vegetable matter, practically all of which was taken in August and September; it consisted of wild fruit (elderberries), a few seeds of poison oak, a few other seeds, and some rubbish.

Animal food.—Of the animal food the largest item is Lepidoptera; that is, caterpillars, moths, and the like. These amount to something more than 43 percent of the whole. Caterpillars make up the great bulk of this portion of the food and are a very constant and regular article of diet. Fewer are eaten in July and August and more at the beginning and end of the season. In April they amount to over 82 percent of the food of the month. Pupæ of codling moths were identified in four stomachs, and minute fragments probably of the same were found in several others. A few adult moths also were found, but the species could not be identified.

Hemiptera are the next most important item of diet, and amount to 21 percent. They consist of stink-bugs, leaf-bugs, leaf-hoppers, spittle-insects, tree-hoppers, and scales. The last were the black olive species (*Saissetia oleæ*). Coccinellid beetles, or ladybirds, were eaten to the extent of over 19 percent of the whole. None was in the stomachs taken in October, while the greater part (over 63 percent) was contained in those obtained in July. The species belong to the genera Hippodamia and Coccinella, which are larger than those of the genus Scymnus selected by the warblers. Other beetles, mostly harmful species, amount to more than 7 percent.

Hymenoptera, which are an important food of the warblers, are conspicuous by their absence in the stomach of the warbling vireo. A little more than 1 percent represents the sum total. They consist of a few ants and an occasional wasp.

A small number of flies, grasshoppers, and dragon-flies make up a little more than 3 percent of the miscellaneous insects. Spiders were eaten to somewhat less than 2 percent.

CASSIN VIREO.

(*Vireo solitarius cassini.*)

This is another of the tree foragers living in summer in orchards, canyons, and forests.

Its food consists of the same elements as that of the last-described species, but in somewhat different proportions. Forty-six stomachs were examined, taken in every month from April to November. They afford at least a fair indication of the food for those months.

Vegetable food.—The vegetable food, which was only a little more than 2 percent of the total, was made up of leaf galls, seeds of poison oak, and a few bits of rubbish. Not a trace of fruit was found.

Animal food.—The animal matter amounts to nearly 98 percent of the whole. Hemiptera are the largest item and amount to nearly 51 percent. The various families represented are those of the squash-bugs, leaf-bugs, stink-bugs, shield-bugs, leaf-hoppers, tree-hoppers, the jumping plant-lice, and scales. The latter are represented as usual by the black olive scale, which was contained in four stomachs. Caterpillars, with a few moths, are next in importance and form more than 23 percent of the whole food. They were eaten in every month and are evidently a favorite diet.

Hymenoptera are eaten much more largely by this species than by the last. They amount to over 7 percent, and are mostly wasps, with a few ants. This record, however, is likely to be modified by further investigation.

Ladybird beetles were eaten to the extent of a little less than 6 percent, which is quite reasonable as compared with the record of the warbling vireo. It is, however, much greater than that of any bird outside the present genus, except the pygmy nuthatch, and in the case of that bird the evidence is too meager to be accepted at its face value. Other beetles amount to a little more than 3 percent of the food, and are mostly weevils and small leaf-beetles (Chrysomelidæ). A few flies, grasshoppers, and other insects amount to somewhat more than 2 percent, and these, with 4 percent of spiders, make up the remainder of the animal food.

SUMMARY.

In glancing over this record of the Cassin vireo it appears that bugs are the favorite food, as shown by the numbers consumed; but caterpillars, though second in quantity, are eaten with greater regu-

larity and appear in the food of every month. The consumption of ladybirds is very moderate for a vireo, and on the whole the bird probably does not do much harm in this way. All the other beetles are harmful, as are most of the other insects which compose the bird's food.

HUTTON VIREO.

(*Vireo huttoni.*)

This species is a resident of most parts of California west of the great interior valley. In food habits it does not differ remarkably from the foregoing, but the various elements of its food are in slightly different proportions.

Vegetable food.—Examination of 54 stomachs shows that less than 2 percent is composed of miscellaneous articles of vegetable origin. One stomach contained a few seeds of elderberries, two contained those of poison oak, and these with a few galls and some rubbish make up the whole of this part of the food. It would seem that with most of the vireos vegetable matter is taken accidentally, or possibly experimentally to see how it tastes, rather than as an approved article of diet.

Animal food.—Of the 98 percent of animal food the largest item is Hemiptera, as is the case with many of the vireos, titmice, and gnatcatchers. These insects amount to 49 percent of the food of the present species, and are represented by the following families: Assassin-bugs, leaf-bugs, stink-bugs, leaf-hoppers, tree-hoppers, jumping plant-lice, and bark scales. These last consist, as is so often the case, of the black scale, which appeared in 8 stomachs. Caterpillars, with a few moths and cocoons, are next in importance, and constitute over 22 percent of the food. These two items not only make up more than two-thirds of the diet, but are eaten with great regularity through the year and seem to be the staples of the bird's food.

Beetles, collectively, amount to nearly 11 percent. Of these 8 percent are ladybirds, somewhat more than were eaten by the Cassin vireo, but only half of the amount eaten by the Swainson vireo. The remaining beetles, less than 3 percent, were largely weevils, among which a few engravers (Scolytidæ) could be distinguished. Hymenoptera, including both wasps and ants, form about 7 percent of the food. Among them several parasitic ones were identified, but there were not enough to be of any great economic interest. A few miscellaneous and unidentified insects amount to nearly 5 percent of the food. Flies and grasshoppers make up a part of this, but they are only rarely eaten. Spiders are consumed regularly but sparingly. They amount to a little more than 2 percent.

OTHER CALIFORNIA VIREOS.

Several other species and subspecies of vireos occur in California, but in the general character of their food they agree closely with the foregoing.

BEETLES FOUND IN STOMACHS OF VIREOS.

Coccinella t. californica.
Hippodamia convergens.
Scymnus spp.
Agrilus spp.
Crepidodera helxines.
Gastroidea viridula.
Blapstinus spp.
Apion cribricollis.
Balaninus spp.
Copturodes koebelei.

WARBLERS.

(Mniotiltidæ.)

The warblers, or more properly the wood warblers, to distinguish them from the warblers of the Old World (Sylviidæ), are a large family of rather small and often brightly colored birds. For the most part they inhabit woods and shrubbery, and while some of them obtain their food from the ground they seldom wander far from trees and bushes. The species and subspecies are so widely distributed that, excepting the deserts, there are no very extensive areas within the boundaries of the United States that do not have their complement of these interesting birds. Their food consists largely of insects, and they subsist upon species which frequent the leaves and trunks of trees. Wasps and flies (Hymenoptera and Diptera) form a large portion of their diet, and as these insects are the best of fliers a considerable portion of them are taken on the wing. The warblers probably eat more of these elusive insects than does any other family of birds except the flycatchers (Tyrannidæ) and the swallows.

Upward of 75 species and subspecies of warblers are known within the limits of the United States, and a majority of these occur in the West, though perhaps they are not so abundant individually as in the Mississippi Valley and Appalachian region.

The genus Dendroica, as the one best exhibiting the characteristic traits of the group, may be taken as the type of the family. There are about 30 species and subspecies of the genus in this country, and the ones whose food is discussed in the following pages occur in California and on the Pacific coast generally.

In a résumé of the food of the warbler family one is impressed with the general noxious character of the insects which compose it. The order of Hemiptera, commonly called bugs, contains some of the worst insect pests that afflict mankind. Moreover, from their small size and unobtrusive habits they are not eaten by many of the larger birds and are difficult to exterminate by the devices of man. But in some of their multiple forms they are preyed upon by the warblers

AUDUBON WARBLER (DENDROICA AUDUBONI).

to an average extent of more than 25 percent of the whole food. Most of the other insect food, also, is either of a noxious or neutral description, and the vegetable portion is so small that it may be disregarded. There is probably no finer tribute to the beneficial character of these birds than that of Dr. Elliot Coues, who says:

With tireless industry do the Warblers befriend the human race; their unconscious zeal plays due part in the nice adjustment of Nature's forces, helping to bring about the balance of vegetable and insect life, without which agriculture would be in vain. They visit the orchard when the apple and pear, the peach, plum, and cherry, are in bloom, seeming to revel carelessly amid the sweet-scented and delicately-tinted blossoms, but never faltering in their good work. They peer into the crevices of the bark, scrutinize each leaf, and explore the very heart of the buds, to detect, drag forth, and destroy these tiny creatures, singly insignificant, collectively a scourge, which prey upon the hopes of the fruit-grower and which, if undisturbed, would bring his care to naught. Some Warblers flit incessantly in the terminal foliage of the tallest trees; others hug close to the scored trunks and gnarled boughs of the forest kings; some peep from the thicket, the coppice, the impenetrable mantle of shrubbery that decks tiny watercourses, playing at hide-and-seek with all comers; others more humble still descend to the ground, where they glide with pretty, mincing steps and affected turning of the head this way and that, their delicate flesh-tinted feet just stirring the layer of withered leaves with which a past season carpeted the ground.[a]

Following is a list of insects, mostly beetles, identified in the stomachs of the warblers examined. A number of these had been eaten by nearly every species:

COLEOPTERA.

Coccinella t. californica.
Scymnus pallens.
Scymnus marginicollis.
Scymnus sp. nov.
Microlipus laticeps.
Melanophthalma americana.
Aphodius rugifrons.
Diachus auratus.
Gastroidea cyanea.
Diabrotica soror.
Crepidodera helxines.
Epitrix parvula.
Bruchus pauperculus.
Blapstinus pulverulentus.
Notoxus alamedæ.
Anthicus difficilis.
Diodyrhynchus hyturoides.
Apion respertinum.
Onychobaris insidiosa.
Balaninus sp.

HEMIPTERA.

Saissetia oleæ.
Aspidiotus rapax.

AUDUBON WARBLER.

(*Dendroica auduboni.*)

(Plate III.)

The Audubon warbler is well distributed over the Pacific coast region, breeding in the mountains and descending in winter to the valleys and plains of California. It is one of the most abundant

[a] Birds of the Colorado Valley, p. 201.

species, and may be considered as typical of the genus, especially in the matter of food. In the winter season it is a frequenter of orchards, gardens, and dooryards where it pursues its business of insect hunting with a persistent assiduity worthy of all praise. At this season it is very familiar and easily approached.

In investigating the food of the Audubon warbler 383 stomachs have been examined. They were taken from July to May inclusive. Geographically they are distributed from the San Francisco Bay region southward to San Bernardino, and probably give a fair idea of the winter diet of this bird in California. The food consisted of nearly 85 percent of animal matter (insects and spiders) and a little more than 15 percent of vegetable.

Animal food.—The largest item of animal food is Hymenoptera—wasps and ants—which aggregate a little more than 26 percent of the whole. By far the greater number of these are ants, and as plant-lice also are eaten to a considerable extent, it is probable that many of the ants are species that take care of the lice. The other members of this order are mostly rapid fliers, so the inference is that they were caught on the wing. The greater number were eaten in the fall and spring months. In our record May appears as the month of least consumption—6 percent. August is the month of greatest consumption—61 percent. This record, however, probably is unreliable, as but one stomach was taken in this month. A few were identified as belonging to parasitic species.

Flies (Diptera) are represented in the stomachs of the Audubon warbler to the extent of a little more than 16 percent, or one-sixth of the whole food. This is one of the largest, if not the very largest, record of this order of insects eaten by any bird except some of the swallows. Even the so-called flycatchers do not eat so many flies as this warbler—in fact, the name 'wasp-catchers' would be much more appropriate for that family. The flies eaten by the Audubon warbler must have been caught in mid-air, for flies as a rule do not allow themselves to be captured without at least attempting to escape. These insects are so soft-bodied that it is not often possible to determine more about them than that they are Diptera. Two families were identified—Muscidæ, the family of the common house fly, and Tipulidæ, or crane-flies, the long-legged mosquito-like creatures otherwise known as "daddy-long-legs." Most of the Diptera, however, are the smaller species, such as gnats, which fly in swarms, and being rather sluggish are more easily captured. They are eaten with remarkable regularity during the whole season, with no decided decrease in the winter months—in fact, more were eaten in January than in either September or April. March is the month of maximum consumption, when Diptera constitute over 54 per cent of the whole food.

Bugs collectively amount to nearly 20 percent, of which a little more than 4 percent are scales and plant-lice. The black olive scale (*Saissetia oleæ*) and another species (*Aspidiotus rapax*) were found in 15 stomachs. Plant-lice (Aphididæ) were contained in 39 stomachs, and from the numbers eaten appear to be favorite food. Several stomachs were entirely filled with them, and the stomachs in which they were found contained an average of 71 percent in each. The remainder of the hemipterous food, more than 15 percent, is made up of stink bugs, leaf-hoppers, and tree-hoppers, with a considerable residue of other remains not further identified. Bugs, as a whole, are eaten rather irregularly, and the greater number are eaten in the fall months, after which the number consumed gradually decreases. Caterpillars are eaten rather regularly by the Audubon warbler, but not in great numbers. They amount to nearly 14 percent of the food of the season, though this figure includes a few moths and chrysalids. Some cocoons of tineid moths were in several stomachs.

Beetles of all kinds aggregate something more than 6 percent of the whole diet. They belong to several families, but the snout-beetles are most prominent. The others belong to about a dozen families, and, except a few carrion and ladybird beetles, are injurious. A few insects other than the above and some spiders, in all a little less than 2 percent, make up the rest of the animal food.

Vegetable food.—The vegetable food of the Audubon warbler consists of fruit, weed seed, and a few miscellaneous substances. As the bird does not visit the fruit-growing regions during the fruit season, it is not chargeable with injury to cultivated crops. Almost all the fruit eaten is wild and of no value, though in the fall it probably feeds to some extent upon various belated products of the orchard. The total of fruit for the season is less than 5 percent, of which the greater amount is eaten in the autumn and early winter, after which the quantity is unimportant.

The most prominent item of vegetable diet, however, is weed seed. This is eaten to the extent of a little more than 9 percent of the whole food, and is taken in almost every month of the bird's stay, the greater quantity in winter. Something more than 31 percent was eaten in December, 22 in January, and 31 in February, after which it decreases regularly to April. One of the most important seeds eaten by the Audubon warbler is that of the poison oak (*Rhus diversiloba* (Pl. II, fig. 9). In most cases the whole seed is not eaten by this bird, but only the waxy outer coating, which is easily identified by certain woody granules which it contains; hence the bird does not aid in the distribution of these noxious plants. The remaining vegetable food, amounting to less than 2 percent, consists principally of rubbish.

SUMMARY.

It must be evident to the most casual reader that this bird is a valuable asset in the orchard and garden. The great bulk of its food, both animal and vegetable, is composed of elements the elimination of which from the farm is a benefit. As has been elsewhere pointed out, the destruction of insects during winter or in early spring is more useful than in the height of the midsummer abundance, for in spring the progenitors of the season's broods are destroyed and with them the possibility of thousands of progeny.

MYRTLE WARBLER.

(*Dendroica coronata.*)

This is another winter visitant in California. Only 10 stomachs of this species have been examined, but the contents show the predominant food characteristic of the genus. There is one point, however, which is worthy of passing note. One of these stomachs was completely filled with greedy scales (*Aspidiotus rapax*), with the exception of a small fragment of a beetle; another contained remains of the black olive scale, and still another some scales not identified.

TOWNSEND WARBLER.

(*Dendroica townsendi.*)

The Townsend warbler, like the Audubon, summers in California only in the mountains. During the migration and in winter it visits the valleys. Like other members of the family it is an insect eater almost exclusively, and does not eat fruit or other farm products. Thirty-one stomachs were taken in the four months from October to January inclusive, in the region from Pacific Grove to Watsonville.

As our stomach examinations disclose the fact that the food of this warbler agrees closely with that of others of the same group, a fair idea of the diet for the above months is obtained.

Animal food.—The animal food consists of insects and a few spiders, and amounts to over 95 percent of the food during the time specified. Of this, bugs make up 42 percent, mostly stink-bugs (Pentatomidæ) and a few leaf-hoppers and scales. The former appear to be a favorite food. Although these insects are eaten with considerable regularity by most of the warblers of this group, they are not usually taken in great numbers, but the Townsend warbler eats many, and several stomachs were entirely filled with them.

Hymenoptera, consisting of both wasps and ants, are eaten to the extent of 25 percent of the food. Most of them are winged species. Perhaps the most striking point in the food of this bird is the great

number of weevils or snout-beetles represented. They amount to over 20 percent of the food, while all other beetles form less than 1 percent. The greater number of these insects were of the species *Diodyrhynchus byturoides*, a weevil which destroys the staminate blossoms of coniferous trees. Five stomachs contained, respectively, 68, 65, 53, 50, and 35 of these beetles, or 271 in all. Moreover, each of these stomachs contained fragments which could not be satisfactorily identified; probably these were the same species, so that the total contained in the 5 stomachs is probably nearer 300. Several other stomachs contained fewer of these weevils. Representatives also of another family of snout-beetles very destructive to timber were present in a few stomachs. These were the engravers (Scolytidæ), which lay their eggs beneath the bark of trees, where they hatch, and the larvæ bore in every direction. Caterpillars and a few miscellaneous insects and some spiders make up the remainder of the animal food.

Vegetable food.—The vegetable matter, which amounts to less than 5 percent of the whole, consists of a few seeds and leaf galls. As the galls in most cases contained small larvæ it is a question if they should not be reckoned as animal food.

SUMMARY.

While this can be considered as only a preliminary study of the food of the Townsend warbler, the thoughtful reader can not fail to be impressed by the fact that this bird exhibits some very valuable economic traits, especially in its relation to the forest. The stomachs containing the pine-eating weevils were from birds killed in the pine forests of Pacific Grove, near Monterey, as also were those containing the engraver beetles. Of the 30 stomachs examined, 19 held the remains of weevils, from which it would appear that these insects are preferred as an article of food. As this group of beetles contains some of the worst pests of the forest and orchard, any bird that eats them so freely must be considered as performing a most welcome service.

SUMMER WARBLER.

(*Dendroica æstiva* subspp.)

The summer warbler, yellow warbler, or summer yellowbird, as it is variously called, is represented in the West by two subspecies, one of which visits California only as a migrant. The other, which does not differ essentially from the eastern form, is a rather common summer resident throughout the valley and foothill regions. In the East this bird is fairly domestic in its habits, and may often be seen about gardens and orchards, or in rose bushes nearer the house. In California it is not quite so familiar, but is becoming so and probably will

soon acquire the habits of its eastern relative. From the material at hand this warbler appears to be even more exclusively insectivorous than the species last discussed. This may arise from the fact that it stays in the fruit districts during summer, when insects are most numerous; but it must be remembered that this is also the season when fruit and vegetable food generally are most abundant.

William Prond, of Chico, Butte County, thus recounts the efficient service of this and other warblers:

> On Rancho Chico is a fine collection of roses, all of which are more or less liable to attacks from *Aphis rosea*, but are perfectly free from other insects. I attribute this to the protection of small birds, among the most active of which are *Dendroica æstiva*, * * * *Helminthophila celata*, *Regulus calendula*.

The following statements in regard to the food of the summer warbler are based on the examination of 98 stomachs, all collected from April to October, inclusive.

Animal food.—The animal food, composed entirely of insects and a few spiders, amounts to over 97 percent. The largest item is Hymenoptera, which amounts to over 30 percent, about half of which are ants. The remainder are small bees and wasps, some of which are probably parasitic species, though none were positively identified. The insects of this order must be favorite food, as they are eaten with remarkable regularity and constitute an important percentage of the diet in every month represented. Caterpillars, with a few moths, aggregate over 18 percent. The greater number are eaten in spring and early summer, but in fall they give place to other insects.

Beetles form nearly 16 percent of the diet, and embrace about a dozen families, of which the only useful one is that of the ladybirds (Coccinellidæ), which are eaten to a small extent. The great bulk of the beetle food consists of small leaf-beetles (Chrysomelidæ), with some weevils, and several others. One stomach contained the remains of 52 specimens of *Votoxus alamedæ*, a small beetle living on trees. Bugs (Hemiptera) constitute over 19 percent of the food, and are eaten regularly every month. Most of them consist of leaf-hoppers (Jassidæ) and other active forms, but the black olive scale appeared in a number of stomachs. Plant-lice were not positively identified, but some stomachs contained a pasty mass, which was probably made up of these insects in an advanced stage of digestion.

Flies seem to be acceptable to the summer warbler; they are eaten to the extent of nearly 9 percent. Some of them are of the family of the house fly, others are long-legged tipulids, but the greater number were the smaller species commonly known as gnats. A few small soft-bodied Orthoptera (tree-crickets), a dragon-fly, and a few remains not identified, in all about 5 percent, made up the rest of the animal food.

Vegetable food.—The vegetable portion is only about 2½ percent. Nearly all of this was fruit pulp contained in a single stomach. This, with one or two seeds and a few accidental bits of rubbish, makes up the whole vegetable contingent, which, therefore, may be dismissed without further comment.

FOOD OF NESTLINGS.

Some idea of the amount of insect food eaten by warblers may be obtained by watching the feeding of their young by the parent birds. A nest of the summer warbler containing two young, about a week old when discovered, was watched for six hours distributed over three days. The nest was situated in a prune tree in an orchard, and it is practically certain that all the food for this family was obtained in the orchard. The results of the observation appear in the following table:

Date.	Forenoon.		Afternoon.	
	Hour of observation.	Number of feedings.	Hour of observation.	Number of feedings.
June 12	.....	.....	3.26–4.26	21
June 14	8.21– 9.21	31	.....	.....
June 14	10.34–11.34	32	4.36–5.36	31
June 15	8.00– 9.00	36	1.11–2.11	30

In six hours 181 feedings were observed, an average of 30⅙ per hour. As there were only two young, it follows that each nestling was fed 15 times per hour, or for a day of fourteen hours 210 times. Both parent birds took part in feeding the young, but it was noted that the female visited the nest most frequently.

SUMMARY.

From the above facts it is evident that the presence of a few warbler nests in an orchard goes far to safeguard the trees from attacks of insect enemies. The inference is plain that the presence of insectivorous birds should be encouraged by the orchardist by every means in his power. The summer warbler is, if possible, even more completely beneficial in its food habits than the Audubon warbler. Its animal food in relation to man is almost entirely noxious or neutral, and it eats so little vegetable food that its character is of but slight consequence.

WESTERN YELLOWTHROAT.

(*Geothlypis trichas* subspp.)

In California the yellowthroat is an inhabitant of marshes and low, bushy places among tules or willows. While it is an insect eater of

the highest order, it does not so directly affect the interests of horticulture as it would if it frequented orchards and gardens. It may be said, however, that as the swamps and thickets in which it lives are the recruiting grounds for many orchard pests, the bird that destroys them in their native haunts is by no means without economic value.

In a somewhat restricted investigation of the food of this bird 114 stomachs, taken in every month except January, were examined.

Vegetable food.—A few seeds and bits of rubbish is the sum total of the vegetable food, and it is probable that these were taken accidentally. Some of the ants of California store up seeds, and when snapping up ants the yellowthroat probably takes the seeds along with them.

Animal matter.—The animal matter amounted to 99.8 percent of the total food. The largest item is Hymenoptera, amounting to 35 percent, of which about half is ants and the remainder wild bees, wasps, etc.

Hemiptera amount to 28 percent, and are made up of leaf-bugs, leaf-hoppers, tree-hoppers, plant-lice, scales, and probably some others not identifiable. The black olive scale was found in a few stomachs and plant-lice in one, but the other families were a pretty constant component of the food in every month.

Beetles were eaten to the extent of nearly 15 percent, and are mostly harmful species, the exception being a few coccinellids of the genus Scymnus, which, however, do not amount to 1 percent of the whole. Weevils and others of the more common families make up the rest of this portion of the diet. The three orders of insects mentioned above form the great bulk of the food of the yellowthroat, and are regularly eaten throughout the year.

Caterpillars and moths comprise 5 percent, but, so far as the stomachs at hand show, are eaten very irregularly and do not appear on the preferred list. The same may be said of Diptera, though they amount to 12 percent, but in several months none were eaten. Grasshoppers were found in only four stomachs, but one of these contained nothing else. Spiders are taken to the extent of nearly 1 percent, but in some months none were found and only a trace in others.

SUMMARY.

From the above rather brief survey of the food of the yellowthroat it is evident that the horticulturist has nothing to fear from this bird should it change its habitat and become an inhabitant of orchards and vineyards. It is practically wholly insectivorous, and the insects it eats are either harmful or of little economic value. It eats no fruit or grain, nor, so far as known, any other useful product. Like other members of the family, its life is passed in unceasing search for insects.

ORANGE-CROWNED WARBLER.

(*Helminthophila celata* subspp.)

The genus Helminthophila is next to Dendroica in the number of species and subspecies it contains, but still falls far below it. Several species occur in California, but the one under consideration is probably the most important. Only 65 stomachs were available for examination, but they confirm the evidence already obtained from other species.

Vegetable food.—Less than 9 percent of the food is vegetable matter, and is made up of 3 percent of fruit and rather more than 5 percent of various substances, such as leaf galls, seeds, and rubbish. Fruit was found in only a few stomachs, but the percentage in each was considerable; figs were the only variety identified.

Animal food.—The animal matter in these stomachs amounts to 91 percent of the food. Hemiptera are the largest item and amount to over 25 percent, mostly leaf-bugs, leaf-hoppers, plant-lice, and scales. Plant-lice were found in only one stomach and scales in 5, of which 3 contained the black olive species. Beetles amount to about 19 percent of the food, and with the exception of a few Coccinellidæ are of harmful families, among which are a number of weevils.

Beetles and bugs are the two orders of insects that are not only eaten to the greatest extent but are taken with great regularity, and form a respectable percentage of the food in every month.

Caterpillars are eaten rather irregularly, though they aggregate 24 percent for the year. Stomachs collected in several months contained none, while in others they amounted to more than half the food. Probably the examination of a greater number of stomachs would show more regularity in the consumption of these insects.

Hymenoptera amount nearly to 15 percent, and are mostly small wasps, though some ants are eaten. This is the smallest percentage for this order that has yet been found in the food of any warbler.

Flies are represented by less than 1 percent, which is unusually small. Perhaps this warbler lacks the skill to catch such agile insects. Seven percent of spiders were found in the stomachs, the largest percentage of these creatures for any warbler. This again indicates that the orange-crown is most successful in hunting sluggish game, such as beetles, bugs, and spiders.

GOLDEN PILEOLATED WARBLER.

(*Wilsonia pusilla* subspp.)

The golden pileolated warbler is another of the small birds that summer here and there on the Pacific coast, mostly in willows and

other shrubbery, but not rarely in the orchard. During the migration it is common and widespread.

Fifty-two stomachs of this bird have been examined, and though the evidence is somewhat fragmentary, it suffices to reveal the general character of the food.

Animal food.—Animal matter amounts to over 93 percent, vegetable to less than 7 percent. Of the former, the larger item is Hemiptera, which aggregates over 35 percent. The black olive scale was found in four stomachs, but leaf-hoppers make up the bulk of this portion of the food. Hymenoptera stand next in importance, with 31 percent, made up of both wasps and ants.

Flies are eaten to the extent of 11 percent, and in connection with the Hymenoptera proves what observation of its habits indicate, that this bird gets much of its food when on the wing. A good many of the insects were the tipulids, or crane-flies.

Beetles of half a dozen different families were eaten to the extent of about 9 percent. They were mostly leaf-beetles (Chrysomelidæ), with a few weevils and one or two others. No coccinellids were found.

Somewhat less than 5 percent of the food consists of caterpillars. They do not appear to be favorite food, for they are eaten very irregularly. Spiders also are taken only sparingly, and form but little more than 1 percent of the total food.

Vegetable food.—The vegetable food, less than 7 percent of the total, is made up almost entirely of fruit pulp, and was eaten in the months of September and October.

SUMMARY.

The foregoing hasty review of the food of the golden pileolated warbler shows that its food habits are practically the same as those of other members of the family. The food is largely composed of insects, and its two most prominent elements are Hymenoptera and Hemiptera, which are eaten extensively and very regularly through the year. The other components of the diet apparently are taken with less regularity.

WESTERN MOCKING BIRD.

(*Mimus polyglottus leucopterus.*)

The mocking bird has always been held in such high esteem as a singer that perhaps it would be useless to attempt to add to the bird's repute by showing that its food habits are of a high order of economic interest. Moreover, the title of the mocking bird to be ranked as an economic benefactor is not quite clear, for, though it

does considerable good by the destruction of harmful insects, it eats much fruit, and from the Southern States, particularly Texas and Florida, where fruit raising is an important industry, have come bitter complaints against it. In Florida the bird is said to attack grapes and oranges, and in Texas it is asserted that figs are to be added to its food list.

In California the mocking bird is a common resident only in the southern half of the State and is very common only in restricted portions. No serious complaints of the bird's depredations in this State have yet been made, but this perhaps is due to the fact that mocking birds are rare in sections where cherries and the smaller deciduous fruits are grown. Where mockers are most abundant, citrus fruits are the principal crop and the birds do not appear to molest them.

While a number of stomachs of this bird have been examined, they are too few and too unequally distributed over the region under investigation to justify final conclusions with regard to the animal food; still they furnish information of value. It so happens that 33 stomachs were taken between July 18 and August 18, and another a few days later. All but one of these stomachs were from the region about Los Angeles, and this one was collected at Fresno. The average, therefore, is a little more than one stomach a day for this period, and gives a fair idea of the food for the time and locality.

The first analysis gives 23 percent of animal matter and 77 percent of vegetable. There was no stomach which did not contain some vegetable food, while 10 had no animal matter.

Animal food.—Beetles of several families formed a little less than 1 percent. Hymenoptera, largely ants, were eaten to the extent of somewhat more than 10 percent. Grasshoppers constituted the largest item of animal food, and amounted to 11 percent of the whole. A few caterpillars and spiders made up the other 1 percent of the animal food.

Vegetable food.—Of the 77 percent of vegetable food nearly 74 percent was diagnosed as fruit. Some of this, of course, was wild, but blackberries or raspberries, grapes, and figs were found in many stomachs. Many of the birds were taken in orchards and gardens, and some were shot in the very act of pilfering blackberries. Others were taken in a wild arroyo away from cultivation. The only species of wild fruits that were identified were elderberries, which were found in a few stomachs. The other vegetable matter was made up of several elements. Of these, the seeds of poison oak (Pl. II, fig. 9) are perhaps the most conspicuous, and one stomach was entirely filled with them. A few weed seeds and some rubbish completed the vegetable part of the food.

Besides the 34 stomachs already discussed, 19 others were examined, but as they represent nine months of the year they are too few to afford a criterion of the usual food for those months; but they give a hint at least of what is eaten at other times than midsummer. Two stomachs were taken in March, one of which was filled with animal food, and the other also, except 1 percent of vegetable rubbish. The animal portion consisted of harmful insects, except one lizard. This seems peculiar food for a mocking bird, and is to be considered beneficial. The one stomach taken in May was filled with seeds of poison oak. A stomach collected in June contained 8 percent of caterpillars; small fruit, probably wild, constituted the rest of the contents. Six stomachs taken in August contained 22 percent of animal matter to 78 of vegetable. The animal food consisted of beetles, ants, and grasshoppers. The vegetable portion was made up of some wild grapelike fruit and a little fig pulp with some elderberries. Of four stomachs taken in September, one was filled with insects and spiders. The three others contained a few wasps, with fruit and other vegetable matter. The only insect to be considered useful was one carabid beetle. Of the three stomachs collected in October, one was filled with the seeds and pulp of grapes and figs; one contained 27 percent of grasshoppers and 73 percent of some wild berry not positively identified, while the third contained a few grasshopper remains and 92 percent of wild seed. The stomach collected in December was filled with seeds and pulp of figs and grapes. One stomach was taken in January which contained 70 percent of harmful insects and 30 percent of seeds of poison oak.

FOOD OF YOUNG.

Among these stomachs was one of a nestling about a week old. It contained 92 percent of grasshoppers and crickets and 8 percent of some wild fruit. So far as it goes, this indicates that mockers follow the general rule and feed their young largely on animal food of the softer kind—that is, grasshoppers instead of beetles.

SUMMARY.

Reviewing the contents of the 52 stomachs we find 29 percent of animal matter and 71 of vegetable. Of the animal food the largest item is Hymenoptera, 10 percent, and then in order, Orthoptera 7 percent, Coleoptera 6 percent, Lepidoptera 5 percent, miscellaneous 1 percent. The vegetable food consists of 50 percent of fruit and 21 percent of seeds and other items. These results prove that the mocking bird eats insects to a considerable extent, but they are not con-

clusive as to the elements of its preferred diet. It is evident that it is fond of fruit, and where abundant the bird may become a menace to the orchard and vineyard.

CALIFORNIA THRASHER.

(*Toxostoma redivivum.*)

Thrashers are eminently birds of the underbrush. While they occasionally alight on trees at some height from the ground, they are more frequently seen under bushes or skulking out of sight in some almost impenetrable thicket of briars. When, however, the thrasher wakes in the morning and feels his soul overflowing with song, he perches on the topmost twig of a tree and lets the world know that he is there and believes that life is worth living.

The food of the thrasher is obtained on or near the ground. The long curved bill of the California species is probably used much as many birds use their claws to dig among dead leaves and other rubbish for insects. The bird is not fastidious in its diet, and examination of the stomachs reveals a good many bits of dead leaves, rotten wood, plant stems, which are carelessly taken along with more nutritious morsels.

An examination of 82 stomachs of this species shows that vegetable food exceeds the animal in the proportion of 59 to 41. In the eastern species (*T. rufum*) the ratio is 36 to 64. This result is rather surprising, for, as a general rule, California birds eat a larger proportion of animal food than do the most nearly related eastern species.

Animal food.—As the thrasher is eminently a ground forager it would naturally be expected to find and eat many ground-living beetles. Of these the Carabidæ are the most important, owing to their predaceous habits; so a separate account of this family was kept. The result shows that they enter the food of the thrasher to the extent only of 3.8 percent, while all other beetles amount to nearly 6 percent. Of these, the darkling beetles (Tenebrionidæ) are the most numerous, and the May beetles (Scarabæidæ) next. But very few weevils or other species that live on trees or foliage were found. Of all the insects, Hymenoptera are the most abundant, as they are also the most constant element of the thrasher's food. About half of these are ants, the rest wasps and bees. Ants naturally are the insects most often found by this bird, as many species live on the ground and among rubbish and rotten wood. The occurrence in the food of wasps and bees, on the contrary, is somewhat of a surprise, as they are mostly sun-loving insects more often found on flowers or the leaves of trees than under bushes or thickets where the thrasher delights to forage. Together they make up something more than 12 percent of the food

of the year. Two specimens of worker honey-bees (*Apis mellifera*) were found in one stomach. None of the other Hymenoptera was of specially useful species.

Caterpillars, cocoons, and moths amount to a little more than 8 percent of the food, and the greater number were eaten during the winter months. It is probable that they were hibernating and were raked out from under dead leaves or other rubbish. A few bugs, flies, grasshoppers, and spiders make up the rest of the animal food—about 6 percent. Spiders and myriapods amount to a little more than 6 percent.

Vegetable food.—The vegetable food may be divided into three parts: Fruit, poison-oak seeds, and miscellaneous vegetable matter. Fruit represents nearly 18 percent, but it probably is not of much value. Several stomachs contained pulp that could not be identified with certainty, and might have been that of some cultivated variety. Seeds of Rubus fruits (blackberries or raspberries) were found in 12 stomachs out of the 82. These, however, are as likely to have been wild as cultivated. Elderberry seeds were discovered in 10 stomachs, Cascara, or coffee berries (*Rhamnus californicus*), in 5, and manzanita berries in 1. The seed of poison oak (*Rhus diversiloba*, Pl. II, fig. 9), and a few of the nonpoisonous species of Rhus were eaten to the extent of 14 percent of the food. They were not found in many stomachs, but appear to be eaten in considerable quantities when eaten at all. The thrasher must be added to the list of birds that assist in the dissemination of the seeds of this noxious plant.

The miscellaneous part of the vegetable food amounts to over 26 percent, and is made up of mast, weed seed, galls, and rubbish. The mast was not further identifiable. Most of the seeds were so broken and ground up that only a few species were identified. Two stomachs contained remains of grain—wheat in one and corn in the other. Leaf galls were found in several stomachs, and rubbish in quite a number, though here again it is difficult to draw the line between food proper and stuff that is accidentally picked up with it.

SUMMARY.

Although the thrashers eat some fruit, most of it is wild and of no value. Moreover, the bird's habits are such as to preclude the likelihood that it will ever become a resident of orchards. Grain evidently is not a favorite food, and if it were it is doubtful if the bird would leave its chosen haunts for the sake of procuring it. It is not probable that the California thrasher will ever become of special economic interest unless under very exceptional circumstances. In the meantime it performs its part in the great work of reducing the vast numbers of insects.

WRENS.

Since the time to which history runneth not the wren family, represented by one or other of its members, has attached itself to the abodes of man. Wherever man settles some member of this group is ready to greet him, to take advantage of his improvements, and to aid in the fight against his insect enemies. The common wren of Europe and the house wren of eastern North America habitually choose crannies in buildings or fences for nesting places, or if hollow trees are selected they usually are near human dwellings, preferably fruit trees in orchards or gardens. When civilization was pushed to the Pacific coast, wrens were there ready to welcome the new order of things. In food habits the wrens proper (Troglodytinæ) are largely insectivorous. While occasionally they eat a seed or a bit of fruit, the quantity taken by most species during the year is so small in comparison to the animal portion as to be insignificant. The insects eaten by the wrens are mostly noxious species, such as infest the foliage and branches of trees and shrubs, and the domestic habits of the wrens enable them to attack these pests in the very places where they are most harmful—that is, in the garden and orchard. The predaceous beetles (Carabidæ), which live mostly on the ground, are protected from the wrens by this very habit, as the latter seldom forages in such places. Moreover, the species most valuable to man are rather large prey for such small birds.

BEWICK WREN.

(*Thryomanes bewicki* subspp.)

The Bewick wren is one of the species which to a considerable extent occupies in California the place of the house wren in the Eastern States. The nesting habits of the two are practically identical, and the economic value of the former is just as great as that of the latter.

Investigation of this bird's food is based upon the examination of 146 stomachs taken in every month of the year. Of its diet for the year a little more than 97 percent consists of insects and less than 3 percent of vegetable matter.

Vegetable food.—The largest quantity of vegetable matter was eaten in December and January and formed about 12 percent of the food in each of these months. In three months—March, June, and September—no vegetable food was found in the stomachs. It is hardly probable, however, that such would always be the case in these months. What was supposed to be pulp of fruit was found in one stomach. This was the only vegetable substance noted that could possibly be useful to man. Six stomachs contained seeds more or less broken, of which only one was identified, a single seed of turkey

mullen (*Eremocarpus setigerus*). In one stomach was a small gall, and in six were various substances, such as bits of dead leaves, plant stems, and rotten wood, which may properly be denominated rubbish.

Animal food.—Of the animal food various families of bugs (Hemiptera) make up the largest percentage. One of the most interesting items is the black olive scale, which was found in a number of stomachs but does not appear to be eaten extensively. The great bulk of the hemipterous food was made up of leaf-bugs, stink-bugs, shield-bugs, leaf-hoppers, tree-hoppers, and jumping plant-lice, though there were representatives of other families. The aggregate of the Hemiptera eaten is about 31 percent of the total food. It is distributed with great regularity through the year and varies less from month to month than any other food. With the exception of the olive scale no specially harmful species was identified, but bugs belonging to the same family as the notorious chinch bug were found. As a vast majority of the members of this order are injurious to vegetation their destruction by birds must be considered beneficial.

Beetles collectively amount to over 21 percent of the food. They may be placed in three groups—ladybirds, weevils, and other beetles. Ladybirds are probably the most useful insects of the whole order of Coleoptera, so that their destruction by birds is to be deplored. Bewick's wren eats them to the extent of a little more than 3 percent of the whole food. This is not a large percentage, though greater than could be wished. On the other hand, the bird eats weevils, or snout-beetles, to the extent of nearly 10 percent of its food. As all the members of this group (Rhynchophora) are practically harmful, and some of them the worst pests of the orchard and forest, it must be allowed that we are paid for our ladybirds at a fairly good price. A number of stomachs contained beetles of this group belonging to the family of engravers (Scolytidæ), which live under the bark of trees and greatly damage the timber. The stomachs of two wrens taken in Pacific Grove in the month of January contained 85 and 80 percent of these beetles.

The owners of the Pacific Grove pine forests have engaged the services of an expert to investigate the damage being done to the pines by scolytids and other insects, and, if possible, to devise a remedy. Is it not evident that the bird under consideration is one of Nature's remedies for this evil? The trouble is that there are not enough birds to wage effective war against the insects. In many cases, perhaps in this one, man himself is partly to blame for present conditions. The birds are destroyed—destruction of the forest follows. By furnishing proper facilities for breeding in the shape of bird boxes the numbers of this wren in the State of California may be greatly increased and the forest trees correspondingly protected from insects.

Other beetles, mostly leaf-beetles (Chrysomelidæ) were eaten to the extent of a little more than 8 percent. While nearly all of the leaf-beetles are theoretically harmful none of those identified in the food are especially destructive to crops.

Hymenoptera, including both ants and wasps, aggregate a little more than 17 percent of the wren's diet. They are a fairly constant constituent of the food and do not appear to vary much according to season. The greater number was found in March, but as only two stomachs were collected in this month the record is not conclusive. Ants form about 7 percent of the food. The economic relations of these insects have been discussed elsewhere. Wasps make up the rest of the item, about 10 percent, and have no especial economic significance. Caterpillars and a few moths and some cocoons constitute a little less than 12 percent of the wren's food. Contrary to what might be expected, not all these are taken in summer. The 14 stomachs obtained in February contained caterpillars to the amount of over 13 percent of their contents. They were probably found hibernating in crevices of bark. A few moths were eaten, but, as usual, they were only a small item of the food. Small cocoons of tineid moths were found in a number of stomachs.

Grasshoppers amount to 4 percent of the wren's diet. Most of them are eaten during the summer and fall, though some appeared in stomachs taken in January. While these insects are a favorite food for many birds they are probably rather large and too terrestrial in habits to be eaten in great numbers by wrens. Other insects, mostly flies and a few remains which could not be identified, make up about 6 percent of the stomachs' contents. Flies (Diptera) are eaten very irregularly and appear not to be relished. Spiders are taken to the extent of somewhat more than 5 percent of the total food. As spiders live about trees, bushes, fences, rocks, and outbuildings it is not surprising that they are captured by wrens, but the rule seems to be that while all insectivorous birds eat spiders to some extent no species eats many.

List of insects found in stomachs of Bewick wren:

COLEOPTERA.

Cercyon fulvipenne.
Hippodamia convergens.
Cocinella t. californica.
Scymnus marginicollis.
Aphodius rugifrons.
Microrhopala montana.
Diachus auratus.
Crepidodera helxines.
Epitrix parvula.
Exema conspersa.
Diabrotica soror.
Cryptocephalus castaneus.
Gastroidea sp.
Bruchus seminulum.
Blapstinus dilatatus.
Notoxus alamedæ.
Ceutorhynchus nodipennis.
Pelenomus cavifrons.
Apion sp.

HEMIPTERA.

Sinea diadema. *Saissetia oleæ.*

Remains of insects belonging to the following families were found, but not further identified:

COLEOPTERA.

Carabidæ.
Hydrophilidæ.
Staphylinidæ.
Coccinellidæ.
Elateridæ.
Scarabæidæ.
Chrysomelidæ.
Bruchidæ.
Tenebrionidæ.
Anthicidæ.
Curculionidæ.
Scolytidæ.
Other Rhynchophora.

DIPTERA.

Muscidæ.
Tipulidæ.

HEMIPTERA.

Emesidæ.
Reduviidæ.
Aradidæ.
Capsidæ.
Lygæidæ.
Pentatomidæ.
Corimelænidæ.
Scutelleridæ.
Jassidæ.
Membracidæ.
Psyllidæ.
Coccidæ.

WESTERN HOUSE WREN.

(*Troglodytes aedon* subspp.)

The western house wren, like its eastern relative, is a common resident about outbuildings and other structures that offer suitable nesting sites and good foraging ground. In its general appearance and habits it is so like the Bewick wren that the casual observer is likely to confuse the two. Like other members of the family, it is largely insectivorous and rarely eats vegetable food.

Only 36 stomachs of this species from California are available for examination, but the character of the food agrees so nearly with that of the eastern form that the general results obtained from the study of that subspecies may be applied to the western bird.

Animal food.—In the 36 stomachs examined animal matter, consisting entirely of insects and spiders, formed 97.5 percent, and vegetable food 2.5 percent. Beetles, as a whole, amount to about 20 percent; caterpillars, aggregating 24 percent, are taken in the earlier months of the year; and Hemiptera, amounting to 33 percent, are eaten chiefly in the last of the season. Grasshoppers amount to about 5 percent, and different insects, mostly ants and other Hymenoptera, aggregate 15 per cent.

Vegetable food.—The vegetable matter consists of rubbish and one grass seed, probably all of it swallowed accidentally.

Among the 36 stomachs, of which the record has just been given, were 18 nestlings, some being about a week old, others about ready to leave the nest. The results of the examination of these were tabulated by themselves in order to determine the differences, if any, between the food of the adults and that of the young. No vegetable matter was found in any of the stomachs, and the animal food was distributed among a comparatively few elements. Bugs (Hemiptera) are the largest item, and amount to nearly 36 percent. Caterpillars and grasshoppers stand next, with 17 and 16 percent, respectively.

It is interesting to note that about three times as many grasshoppers are fed to the young as are eaten by the adults. Wasps and ants amount to a little more than 6 percent, and are the smallest item. Spiders appear to the extent of a little over 11 percent. Beetles, however, constitute the most interesting item of the food. They were eaten to an average extent of somewhat more than 11 percent, and were nearly all ladybirds (Coccinellidæ) contained in the stomachs of five individuals of a brood of six. The amount in each stomach varied from 15 to 65 percent of the contents, and averaged 29 percent of each of the six birds. It is a question which is the more surprising, that this brood had eaten so many coccinellids, or that the others had eaten so few. Only three other stomachs contained any of these beetles and those were all adults. The house wren does not exhibit any special proclivities for ladybirds, and it would seem probable that in this case either other food was wanting or these beetles were specially abundant.

In addition to the examination of stomachs, observations were made upon the feeding of nestling wrens. A nest situated in the porch of the house of Mr. W. O. Emerson, at Haywards, Cal., was observed for one-hour periods from soon after the young were hatched until they were nearly ready to fly. The nest was watched at various times of day, so as to include as nearly as possible all hours of daylight. During the first two periods the male aided in feeding the young, but afterwards was not seen, and the whole care of the young devolved upon the mother. The number of young probably was not fewer than six. Following are the results in tabular form:

Date.	Forenoon.		Afternoon.	
	Hour of observation.	Number of feedings.	Hour of observation.	Number of feedings.
May 18...	10.00–11.00	8	4.00–5.00	7
May 19...	9.35–10.35	13	4.30–5.30	10
May 20...	10.29–11.29	16	.....	.....
May 21...	8.23– 9.23	20	2.01–3.01	12
May 23...	8.22– 9.22	19	.....	.....
May 26...	10.35–11.35	32	.....	.....
May 27...	.....	.....	2.36–3.36	31
May 28...	8.20– 9.20	38	.....	.....
May 30...	10.40–11.40	28	.....	.....

As will be noticed, the whole time of observation covered a period of thirteen days, although the nest was not watched every day. In all the nest was watched for twelve hours, and the total number of times that food was brought to the young was 234, or an average of 19½ times per hour. The young were fed as early as 5 o'clock in the morning and as late as 7 in the evening, thus making for the parent birds a working day of fourteen hours. Only a little plain arithmetic is necessary to show very nearly the number of insects destroyed by this family in a single day.

These observations were made with watch in hand and the time of each feeding noted. In many cases the parent bird was away in search of food only half a minute. Once there was a heavy mist nearly all day, when the mother wren was hard pressed to find food for the ever-gaping mouths of her young. No flying insects were abroad, and the supply of caterpillars from the immediate vicinity had been exhausted. In this extremity the mother turned her attention to spiders and was seen to visit the interior of a summer house, also to investigate a pile of flower pots and tubs and to plunge into and under an evergreen hedge in search of something that would answer for food. As the nest was watched at very short range, it was often possible to determine the nature of the food brought by the parent. When the nestlings were very young, it consisted almost entirely of small green caterpillars, commonly called 'canker-worms.' Later this was varied by tipulid flies (daddy-long-legs), small moths, and spiders. Some of the insects brought were not determinable, probably flies and wasps.

SUMMARY.

From the above sketch of the food of the house wren it will be seen that there is practically only one item to which exception can be taken, namely, the coccinellid beetles, or ladybugs. But the record is so meager that it is not safe to draw general conclusions. It is probable that a more extensive investigation of the food of the California bird will show that it is entitled to the same high economic rank as its eastern relative.

WESTERN MARSH WREN.

(*Tcmatodytes palustris* subspp.)

The marsh wren, as its name indicates, is a resident of swamps and marshy grounds. At first thought its food might not appear to be of any economic importance, but investigation shows that it does not differ from that of the orchard wrens as much as one might infer from difference of habitat. Only 53 stomachs of this species have been obtained for examination. While this number is not sufficient as a basis for final judgment, it suffices to show how closely the food of this species resembles that of its congeners.

Vegetable food.—But little vegetable food was found in the stomach of the marsh wren, and the precise value of most of that was not determinable. A few seeds of sedge and one of amaranth were all that were identified. The total amount was a trifle over 2 percent.

Animal food.—Beetles, wasps, ants, bugs, caterpillars, and a few miscellaneous insects, with some spiders and snails, make up the bill of fare. As with the Bewick and the house wren, bugs are the largest item, but do not quite equal the quantity eaten by those industrious bug-hunters. While the Bewick eats these insects to the extent of 31 percent of its food, the marsh wren eats them only to the amount of 29 percent. In this respect there seems to be little difference between the bird that gets its food from trees and the one that feeds among the tules and sedges. The families represented are those of the assassin-bugs, damsel-bugs, leaf-bugs, stink-bugs, leaf-hoppers, and tree-hoppers, most of which are usually found on trees—in fact, one is forced to the conclusion that the marsh wren must at times forage upon trees or shrubs. Scales were found in one stomach, which is another point of resemblance between the diet of this bird and that of the habitual tree inhabiters.

In the marsh wren's food caterpillars and chrysalids rank next to bugs in importance. They amount to about 17 percent of the whole, and appear in the food of every month. Cocoons of tineid moths were contained in a number of stomachs, another indication that the birds visit trees.

Beetles constitute 16 percent of the food. While a number of the commoner families are represented, the terrestrial forms are rather more prominent than in the food of the arboreal wrens. A few carabids and a number of coccinellids together make up 2 percent of the food, and were the only useful insects eaten, unless the assassin-bugs are reckoned as such. As these feed on other insects they must of course do some good. Ants and wasps amount to about 8 percent of the food, and most of them were eaten during the fall months. Flies, grasshoppers, dragon-flies, and a few insect remains not further identified make up over 11 percent of the food. They were eaten very irregularly. Spiders constitute somewhat more than 3 percent, and, as usual, are very regularly eaten, but in small numbers. Small mollusks (snails) were eaten by quite a number of birds, and 1 stomach contained 11 specimens.

SUMMARY.

This brief review of the food of the marsh wren, while not absolutely conclusive, is sufficiently near the truth to prove that the bird is to be ranked among our eminently useful species. Of some birds it has been said that their peculiar merit lies in the fact that they reside in orchards and cultivated ground and hence destroy insect

pests in the very places where their mischief is done. This can not be asserted of the marsh wren, but it must be remembered that many harmful species of insects breed and live in marshes and waste places as well as in grainfields and orchards, so that the birds which destroy them on wild lands are removing the source of supply from which are recruited the hosts that infest the farm.

CACTUS WREN.

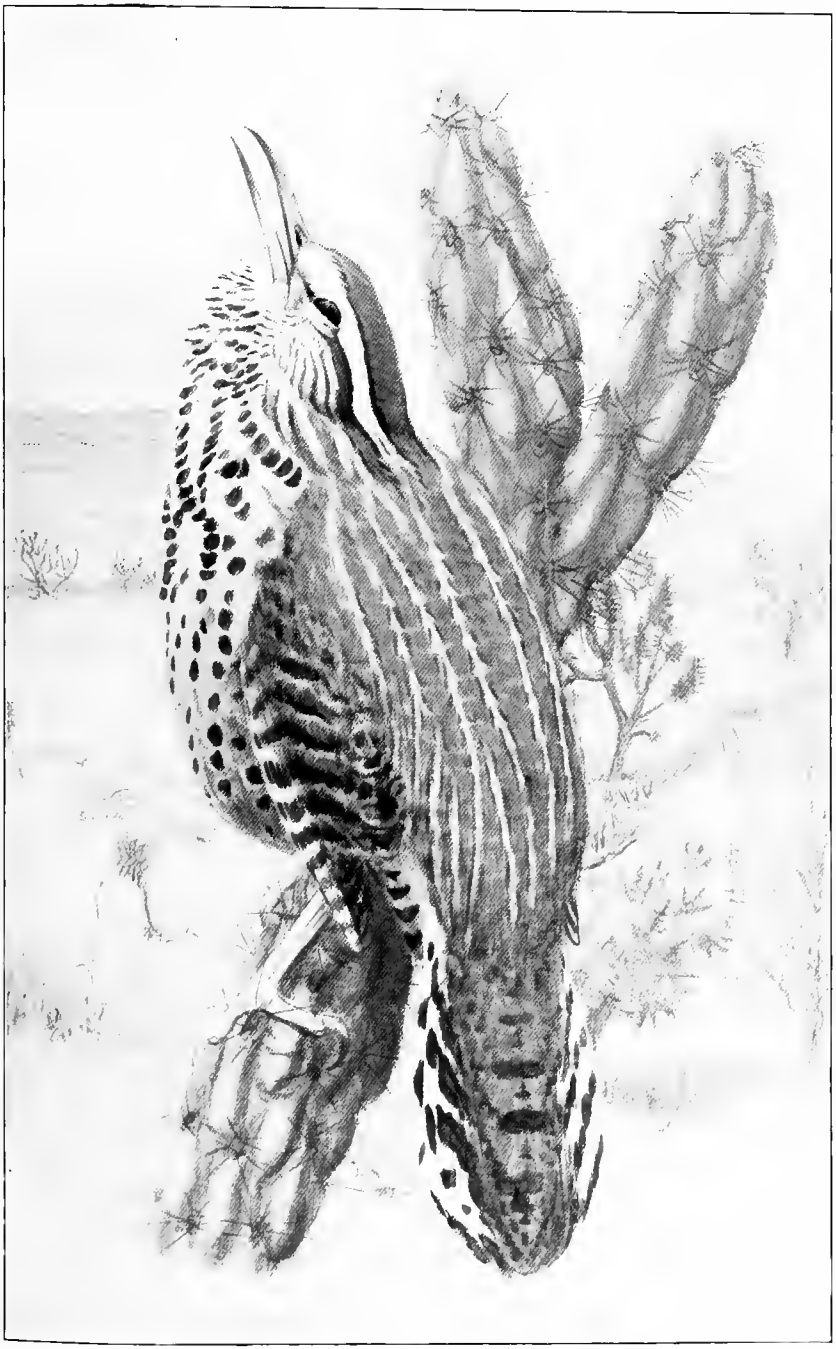
(*Heleodytes brunneicapillus.*)

(Pl. IV.)

The cactus wren is so exclusively a bird of the desert and waste places that its food may be thought to have little, if any, economic interest. It is not safe to assume, however, that the bird will never affect the interests of agriculture because it does not do so at present. Moreover, its food habits have a scientific interest which justifies a brief review. A number of the birds whose stomachs have been examined for this work were taken near orchards and grainfields, and there can be little doubt that, with the spread of cultivation, the species will adapt itself to a somewhat different environment and become of economic importance. We find, in fact, that its food is made up of practically the same orders and families of insects that compose the diet of birds living on agricultural lands, but the relative proportions differ widely, and in most cases the species are probably different.

Only 41 stomachs of the cactus wren were available for examination. They were taken in the region from Los Angeles to San Bernardino, and from July to January, inclusive. They contained about 83 percent of animal matter to 17 of vegetable.

Animal food.—Beetles and Hymenoptera, the latter ants and wasps, were the two most important items of the animal food. Each made up about 27 percent of the total. The beetles belong to several families, but weevils, or snout-beetles, were the most noticeable, and amount to somewhat more than 10 percent. One stomach contained 11 of these insects and another 10, while others held fewer. Only one species, *Rhigopsis effracta*, was identified. Five of these were in 1 stomach. The other beetles belong to more common families. Coccinellids were found in 1 stomach and carrion beetles in 2. They were the only insects noted that can be considered as useful. Hymenoptera are represented by many ants and a few wasps. These are just the insects which the cactus wren might be expected to find, for dry land and sunshine are the conditions which favor these creatures. Grasshoppers amount to a little more than 15 percent. This



CACTUS WREN (HELEODYTES BRUNNEICAPILLUS COUESI).

is the only wren that eats these insects to any considerable extent except as nestlings.

Bugs (Hemiptera) amount to only a little more than 5 percent of the food, which is the smallest quantity eaten by any of the wren family. This item, however, contains one unexpected element—that is, black scales (Saissetia). These appeared in 6 stomachs, and must have been obtained from trees or shrubs, possibly from fruit trees. In any case their destruction is a welcome service. Caterpillars and their allies (Lepidoptera) were eaten to the extent of a little more than 5 percent. Among them were many cocoons of tineid moths, indicating again that the cactus wren obtains some of its food from trees and shrubs. A few unidentifiable insects and spiders amount to somewhat more than 3 percent. This is the smallest record for spiders of any of the wren family, which is much given to eating these creatures, finding them in crannies in rocks, stumps, and other places. A few of the long bones of a tree frog were found in 1 stomach.

Vegetable food.—Seventeen percent of vegetable matter was found in the stomachs of this bird. This is the largest percentage found in the stomachs of any species of wren yet examined. The vegetable food of the cactus wren consists of fruit pulp and weed seeds. The former amounts to nearly 13 percent, but in all cases where identification was possible consisted of wild species. Of these, only 3 were fully identified—cactus (Opuntia), elderberry (Sambucus), and Cascara (Rhamnus), the last only in 1 stomach. Nothing was found to indicate that cultivated varieties had been eaten. Seeds, which amount to 4 percent, are those of the poison oak (Rhus), and a nonpoisonous species, with filaree (Erodium) and Amisinckia, most of them useless plants or worse.

SUMMARY.

From this brief inspection of the cactus wren's food it is seen that it contains but little that is useful to man, while the great bulk is made up of elements that are, or would be, harmful if present on cultivated lands. The bird thus sustains the good reputation of the rest of its family.

OTHER WRENS.

Some half a dozen stomachs each of the western winter wren (*Olbiorchilus hiemalis pacificus*) and dotted canyon wren (*Catherpes mexicanus punctulatus*) and the rock wren (*Salpinctes obsoletus*) have been examined. This number is entirely too small to serve for specific statements in regard to their food except that it may be said

that it corresponds closely to that of the other species of the family discussed in foregoing pages.

From this somewhat limited investigation of the food of the California wrens several points may be regarded as established: (1) That these wrens are essentially insectivorous; (2) that an overwhelming majority of the insects composing their food are harmful species; (3) that the quantity of vegetable food eaten is so small as to have no economic importance.

CALIFORNIA CREEPER.

(*Certhia familiaris occidentalis.*)

Only 7 stomachs of the California creeper were available for examination, but they confirm the good opinion observers have formed of the habits of this bird. Like the titmice and nuthatches, the creeper is an indefatigable forager on the trunks and branches of trees, and the food it obtains there is of the same nature—that is, small beetles (many of them weevils), wasps, ants, bugs, caterpillars, and a few spiders. Of the 7 stomachs examined, only 1 contained vegetable food, and this had only 19 percent of seed, too much digested for identification.

While the creeper is not systematically classed with the nuthatches and titmice, its food habits closely ally it to these birds and to the wrens, and whatever good is true of them applies with equal force to the creeper.

NUTHATCHES AND TITMICE.

(Paridæ.)

Few families of birds contain so many absolutely harmless and thoroughly useful species as that of the nuthatches and titmice. All of the American species are small, and several are so minute that the larger species of humming birds exceed them in size. In colors they are neither brilliant nor showy, black, white, brown, and gray being the predominant tints of their plumage. In manners and voice they are equally unobtrusive, and so little do their movements attract attention that one may be surrounded by them in the forest before he is conscious of their presence. More than forty species and subspecies of the titmouse family reside within the limits of the United States, of which some fifteen live in California.

From an economic standpoint the titmice are the reverse of insignificant. They are essentially inhabitants of trees and shrubs, and obtain almost their entire living from them. Their food consists largely of small insects and their eggs and larvæ, and, as the individuals of most of the species are numerous and spend all the daylight hours searching for food, it follows that the number of harmful

creatures they destroy is beyond calculation. As conservators of forest and orchards there are few birds that compare with them. The insects they destroy are largely those that feed upon the leaves, blossoms, and fruit of trees, with some that bore into the wood or burrow under the bark, thereby injuring or killing the tree itself. On the other hand, they do not prey upon fruit, grain, or other product of husbandry. The small amount of vegetable matter they eat consists principally of small galls, whose destruction is a benefit, with a few seeds and a little wild fruit.

PYGMY NUTHATCH.

(*Sitta pygmæa.*)

The nuthatches are small, inconspicuous birds that live upon trees and for the most part remain in forests or groves, though not rarely visiting the orchard. While allied to titmice they form a fairly well-defined group and can be easily distinguished from titmice proper. As gymnasts they probably lead the avian world. After watching their movements one might suppose that nature had quite exempted them from the operation of the laws of gravity, as they move up or down a tree with equal facility, or along the underside of a horizontal branch where they inspect a promising knot hole or cranny, apparently without the least idea that they are upside down. The food they obtain from trees is of the same general character as that of the rest of the titmouse family.

Unfortunately only a few stomachs of these birds are at hand for examination—enough, however, to give a general idea of the diet.

The pygmy nuthatch is the smallest of the group, but as a destroyer of noxious insects it is far from insignificant. Only 31 stomachs of this feathered midget are available for examination, but the number is sufficient to bring out some strong points of the bird's diet. The relative proportions of animal and vegetable food, as indicated by the contents of these stomachs, are approximately 83 percent of the former to 17 percent of the latter.

Animal food.—The largest item of animal food is Hymenoptera, composed mostly of wasps, with a few ants. They amount to about 38 percent of the whole. Next in order are Hemiptera, aggregating 23 percent. A large proportion of these belong to the family Cercopidæ, commonly known as spittle-insects, from the fact that they develop inside of a froth-like substance resembling saliva produced in summer upon grass and various plants and trees. While none of these insects have yet become pests, there can be no doubt that collectively they do considerable harm to plants, as sometimes they are very abundant and subsist entirely upon their sap.

In this connection peculiar interest attaches to the contents of 20 stomachs of the pygmy nuthatch from the pine woods of Pacific Grove, near Monterey, June 24 to July 13. Eighteen of these stomachs contained remains of Cercopidæ, and six were filled with them. The average for the 18 stomachs is a little more than 76 per cent of all the food. They were not identified specifically, but undoubtedly are one of the several species known to feed upon the pine. Beetles of various families form about 12 percent of the food. There were many weevils, or snout-beetles, in the stomachs, and some coccinellids, which were the only useful insects found. They amount to 9.6 percent, which is the largest record for any bird yet examined, except the vireos; but as this percentage is based upon the examination of so few stomachs, it can not be considered as wholly reliable. Caterpillars amount to 8 percent, and with a few spiders (1 percent) account for the rest of the animal food.

Vegetable food.—The vegetable portion is made up almost entirely of seeds, of which a majority are those of conifers, as was to be expected from the habits of the bird.

Two other species of nuthatches, the slender-billed (*Sitta c. aculeata*) and the red-breasted (*Sitta canadensis*) occur in California. A few stomachs of each have been examined and the contents found to agree substantially with the foregoing.

SUMMARY.

In conclusion, it may be said that, like other genera of the Paridæ, nuthatches are eminently useful birds. They do not prey upon cultivated crops, eat but few useful insects, and probably are among our most efficient conservators of the forest and of the orchard.

PLAIN TIT.

(*Bæolophus inornatus.*)

(Plate V.)

The plain tit, like the rest of its family, is quiet and unobtrusive, attracting little notice by its voice and movements, and probably is the most modestly dressed of them all. While it seems to prefer to hunt on oaks, it does not neglect fruit trees, and often may be seen flitting about the orchard.

The general character of its food is the same as that of other small arboreal species. The relative proportions consumed, however, differ somewhat from those taken by other members of the family. The plain tit eats a greater proportion of vegetable food than any other titmouse so far as known, and, what is more remarkable, a large part of this consists of the pulp of fruit.

PLAIN TITMOUSE (BAEOLOPHUS INORNATUS).

The following brief account of the food of this bird can be considered only preliminary, as but 76 stomachs were available for examination. These, however, are distributed through the year, so that every month is represented by at least three. While these results may be modified by future investigation, they probably afford a fair general idea of the yearly food of the species.

Animal food.—Unlike most of the titmice, the plain tit eats less animal than vegetable food, the proportion being 43 percent of animal to 57 of vegetable. Examination of a greater number of stomachs may modify these figures but probably will not reverse them. The animal food is quite evenly divided among a number of elements, but, as with the bush tit, bugs (Hemiptera) appear to be the favorite, mostly eaten during the summer months. These amount to 12 percent of the food. This is a little more than one-fourth of the amount of Hemiptera eaten by the bush tit. The black olive scale is a prominent element of this part of the diet, and forms nearly 5 of the 12 percent. In the month of August nine stomachs were taken, and 34 percent of their contents consisted of these scales, while one stomach was filled with them. The plain tit probably eats this insect more or less throughout the year, but the limited number of stomachs under consideration does not warrant a positive statement. The other hemipterous food consists of representatives of several families, such as leaf-hoppers (Jassidæ), jumping plant-lice (Psyllidæ), tree-hoppers (Membracidæ), and other remains not identified.

Lepidoptera, represented mostly by caterpillars, are the next most important ingredient of the food. They amount to nearly 11 percent, and are mostly eaten during the warm months, though one stomach taken in March was filled with caterpillars and one moth.

Beetles (Coleoptera) are next in importance in the food, of which they form nearly 7 percent. All are harmful species, but the members of one family are especially interesting. The genus Balaninus is composed of weevils in which the snout attains its greatest length, and sometimes is as long as the rest of the body. The insects, by means of this long snout, bore into nuts and acorns, wherein they deposit eggs, which hatch grubs that eat the nut. The tit finds these beetles while foraging upon the oaks. One stomach contained the remains of 13 of them, another 11, a third 8, and a fourth 7, while others contained fewer. The plain tit feeds upon mast to some extent, and it is interesting to note that some of the stomachs which held remains of Balaninus contained acorn meat also, showing that the birds found the one while foraging for the other.

Hymenoptera in the shape of ants amount to nearly 4 percent, while wasps make up the total of this order to about 6 percent.

Other insects aggregate a little more than 5 percent. Tipulid flies (daddy-long-legs) were found in several stomachs, as were grasshoppers also. One stomach contained the remains of 13 of the latter, a remarkable number for so small a bird, but the bulk was not great, and they were probably the débris of several meals. Spiders are a very constant article of food, but do not appear in great numbers, as the average for the year is somewhat less than 1 percent.

Vegetable food.—In the vegetable food of the plain tit, fruit amounts to nearly 32 percent. Fruit is a rather surprising item of the food of this bird, as no one, so far as the writer can learn, has ever accused it of destroying fruit. The quantity is three times as much as is eaten by the linnet, and is another illustration of the fact that in estimating the status of a species the number of individuals as well as the amount eaten by each individual must be considered. The fruit consumed appears to be of the larger cultivated varieties, as no seeds of wild berries were found.

Cherries were identified in a number of stomachs, and pulp of the larger fruits was abundant. As considerable of this was contained in stomachs taken in the late fall and winter months, it is evident that it was refuse left on the tree and of no value. Not only does the plain tit eat fruit, but to some extent it indulges also in grain. Oats were found in a number of stomachs and constituted nearly 30 percent of the contents of two stomachs taken in January. Grain is probably not eaten to any considerable extent, however, as the amount for the year is but little over 1.5 percent, and oats was the only variety identified. Leaf galls, seeds of poison oak, weed seeds, unidentifiable matter and rubbish make up the remainder, 24 percent, of the vegetable food. None of these are of much economic importance, except that the distribution of poison-oak seed is a nuisance.

SUMMARY.

From this somewhat imperfect review of the food of the plain tit it is evident that in its present numbers it is useful. The insects it eats are practically all harmful and the scales exceedingly so. Moreover, its habit of foraging in trees enables it to capture some of the worst enemies of fruit and renders its work in this direction invaluable. On the other hand, it eats quite a large percentage of fruit, most of which appears to be of cultivated varieties, and should the bird ever become as abundant as the linnet now is it would undoubtedly be a pest. This contingency, however, is extremely unlikely.

CHESTNUT-SIDED CHICKADEE.

(*Parus rufescens* subspp.)

While this bird at present inhabits mountain regions rather than orchards, still it may not be out of place to give a short digest of our

knowledge of its food. Fifty-seven stomachs were available for examination, and these were taken in every month of the year, except March, April, and May. The food consisted of nearly 65 percent of animal matter and 35 of vegetable.

Animal food.—Caterpillars constitute 18 percent of the animal portion. They were found in nearly every month in which stomachs were taken, there being a fairly good percentage even in January and December. The greatest amount, 53 percent, was eaten in August. Hemiptera, consisting of leaf-hoppers, tree-hoppers, and olive and other scales, constitute the most important item of food, and amount to about 25 percent. These were found in all except two winter months. Wasps were eaten to the extent of 13 percent of the food, but no ants were found. Beetles amount to less than 2 percent of the food, but nearly all are noxious; weevils appeared in one stomach. Flies and grasshoppers are conspicuous by their absence, and not even a trace of one was discovered. Spiders are a very constant element of the food of nearly all the titmice. In that of the chestnut-side they amount to nearly 7 percent for the year, though in August they constitute nearly 16 percent.

Vegetable food.—The vegetable portion of the food consists of fruit pulp 8 percent, seeds nearly 20 percent, and miscellaneous matter 7 percent. Fruit pulp was found only in a few stomachs taken in the fall and winter and was probably waste fruit. The seeds eaten were mostly those of coniferous trees, as was to be expected of a bird which spends so much of its life in evergreen forests. The miscellaneous items of the vegetable food are leaf galls, bits of moss, and rubbish.

SUMMARY.

The above sketch of the chestnut-sided chickadee, while very imperfect, suffices to show the general character of its food. A few stomachs also of the mountain chickadee (*Parus gambeli*) have been examined and the contents found to agree in a general way with the food of others of the group.

WREN TIT.

(*Chamæa fasciata* subspp.)

This modest, secretive bird, like the eastern chat, is more often heard than seen. At present it does not often live in orchards and gardens, and when it visits these it sticks closely to hedges and the denser parts of the shrubbery. In general it keeps to its original abiding places in the dense chaparral of canyons and hillsides. So long as it is confined chiefly to these situations its food habits will never be of

more than secondary importance, but as cultivation spreads the bird will be forced more and more to reside in cultivated districts.

The number of stomachs available for examination is 165, and as they represent every month except July they afford a fair idea of the salient features of the bird's yearly food. Of this 52 percent is animal matter, insects and spiders, and 48 percent of various vegetable substances.

Animal food.—The most important item of the animal food consists of ants and wasps (Hymenoptera), which amount to 23 percent of the whole. This is in strong contrast to the bush tit, whose diet contains scarcely any of these insects. About half of the Hymenoptera are ants. This is exactly what might be expected of a bird of such terrestrial habits and one so given to lurking under bushes and about decayed logs and rubbish. The other insects of this order are small wasps. Beetles, collectively, the next most important item of food, amount to about 10 percent. The only useful species identified were a few ladybirds (Coccinellidæ), and a separate account of these was kept in order to estimate the harm done by their destruction. The result shows that the diet of the wren tit contains less than 1 percent of these useful beetles. The remaining beetles belong to various families, all of them harmful to vegetation. Caterpillars constitute a little less than 8 percent of the food, and are a very constant element of the diet. They appear to be eaten at all seasons, but in the early summer they amount to about one-fourth of the food. Quite a number of cocoons of tineid moths also were present in the food.

Bugs (Hemiptera) are eaten to the extent of about 7 percent of the animal diet. In this respect the wren tit differs from the bush tit, over 44 percent of whose food is made up of these noxious insects. In one particular, however, the two birds are alike; scales (Coccidæ) are prominent in the food of both. The black olive scale (*Saissetia oleæ*) and the greedy scale (*Aspidiotus rapax*) were identified in the stomachs of both birds, and many not specifically identified were found. The scales were probably obtained from orchards, as it is not likely that these insects have spread to wild plants and forest trees. As scales are to be had at all seasons they are a constant element of the food of tits. The remaining animal food, less than 5 percent, is composed of various insects and some spiders. One stomach contained the legs of a grasshopper and another the remains of a wood-cricket. These are the only orthopterous remains in any stomach. Flies (Diptera) were eaten very sparingly. Spiders appeared in a great many stomachs but not in large numbers. They amount to a little less than 2 percent of the food. In one stomach were found 26 mites, commonly parasitic on beetles and other insects. Their hosts had probably been eaten by the tit.

Vegetable food.—The vegetable contingent of the food, 48 percent, is made up of various substances, but may be arranged in three categories—fruit, poison-oak seeds, and other vegetable matter. Fruit, identified by seeds, pulp, and skins, amounts to a little more than 20 percent of the whole food. Few direct complaints, however, have been lodged against the wren tit on the score of damaging fruit, and yet this record is nearly twice that of the linnet—the bird against which the heaviest charges are made by the orchardist. The reason for this difference is probably not far to seek. There are undoubtedly a hundred linnets in California to one wren tit. This again illustrates the point before made, that the mischief done by birds usually results from a superabundance of the individuals of a particular species, all uniting simultaneously to attack some particular product. Moreover, the fruit consumed by the wren tit consists largely of wild varieties—such as elder berries (Sambucus), snow berries (Symphoricarpos), coffee berries (Rhamnus), twinberries (*Lonicera involucrata*), and others of a similar character. Seeds of blackberries or raspberries (Rubus) were found in a few stomachs, but these may have been either wild or cultivated.

As the seeds of poison oak (*Rhus diversiloba*) occurred in many stomachs a separate account of them was kept. From August to February, inclusive, they form a constant and important element of the diet. For these seven months they constitute more than one-fourth of the food, and the average for the year is over 16 percent. It seems natural enough that the wren tit should eat these seeds, as they are abundant and easily accessible. The fact is to be deplored, however, as they are not destroyed in the stomach, but either pass through or are regurgitated in condition to germinate. The seeds apparently are eaten for the sake of the rather thin layer of dry white pulp that surrounds them. No doubt this is very nutritious, as in winter poison-oak seeds are a common article of diet for many species of birds. The rest of the vegetable food, over 11 percent, is made up of a few weed seeds, leaf galls, and rubbish. None of it has special economic significance.

FOOD OF YOUNG.

Among the stomachs examined were those of a brood of 5 nestlings about two weeks old, and therefore nearly ready to leave the nest. The results are of interest as showing that the wren tit follows the usual rule and feeds its young entirely on animal food. The largest item is caterpillars, which amount to 63 percent of the contents. Spiders, with their cocoons and eggs, are next in importance, with 15.6 percent. Bugs, mostly leaf-hoppers, form 12.2 percent. Beetles of the May-beetle family, with a trace of eggshell,

make up the remainder, 9.2 percent. One can not fail to notice the soft nature of most of this food provided for the young. The beetles are the only exception, and these were the smallest item.

SUMMARY.

In summing up it is evident that so far as its natural food is concerned the wren tit does little or no harm, as coccinellid beetles, the only really useful insects it eats, are consumed very sparingly. Its vegetable diet presents two points for criticism. It eats a moderate amount of fruit, and were the bird as abundant as the linnet the harm it would do in orchards would perhaps more than counterbalance the good. The wren tit, however, naturally is a denizen of dense shrubbery, and as this is cleared away for farms and orchards the species is likely to diminish in numbers rather than increase, unless its habits radically change. The consumption of the seeds of poison oak is an unfortunate habit, since it aids in the dissemination of this poisonous plant, already too common and widespread. All things considered, the wren tit for the present is to be classed as beneficial.

CALIFORNIA BUSH TIT.

(*Psaltriparus minimus californicus.*)

(Frontispiece.)

The bush tit is one of the smallest species of the family, and although its name implies that it is partial to bushes, it more often is seen in large oaks and frequently on the tops of the highest trees. It shows the same indifference to the presence of man as the rest of the family, and frequently may be observed scrambling over orchard trees in search of its favorite food and paying no attention to the observer. That it does not prey upon fruit to an appreciable degree appears from the fact that less than 1 percent of its food for the year consists of fruit. Insects that live on trees, however, constitute four-fifths of its food, and most of these are harmful.

In the investigation of the food of this bird 353 stomachs were examined. They were collected in every month of the year, although April is represented by but a single one and March by only six. The greater number were taken during the growing months, when fruit and grain abound, and the fact that in these months the bird ate almost none of these products speaks volumes in its favor. The first analysis of the food of the year gives nearly 81 percent animal matter, composed entirely of insects and spiders, to 19 percent of vegetable. As the bush tit inhabits the same range during the year, monthly variations in the kind and proportions of food are only

such as seasonal changes necessitate, and as these do not largely affect insects, which constitute the great bulk of the bush tit's food, it follows that the variation in diet from one month to another is not great. The smallest quantity of animal food was in March, when it amounted to 53 percent, but the percentage was almost exactly the same for November. One stomach taken in April contained nothing but insects and spiders, and 11 collected in June contained no vegetable food. Probably examination of a greater number collected in these months would result differently. While the material available for the present investigation is not so extensive as could be desired, it is sufficient to indicate beyond reasonable doubt that the relative proportions of animal and vegetable food in the diet of the bush tit vary little from season to season.

Animal food.—The largest item in the insect portion of this bird's food consists of bugs (Hemiptera), which amount to over 44 percent of the whole. The gnatcatchers are the only birds yet investigated whose diet is made up so largely of this order of insects. Moreover, the particular families of Hemiptera so extensively eaten by the bush tit are the two that are most destructive to the interests of horticulture—namely, the plant-lice (Aphididæ), and bark-lice, or scales (Coccidæ). The last amounts to nearly 19 percent of the year's food, and are eaten in every month. The greater number are consumed in July, 46 percent; June follows second in rank, when they constitute 33 percent of the food of that month. The large black olive scale (*Saissetia oleæ*) was identified in 44 stomachs, but other species also were found. The question is often asked, Does any bird feed upon the San Jose scale? While the writer is not prepared to give a positive affirmative answer from direct evidence, there can be no reasonable doubt that this insect is often eaten by birds. It must be borne in mind, however, that the so-called San Jose scale is one of the smaller species, and its distinctive characters are so minute that after it has been taken into a bird's stomach, mixed with other food, and more or less digested, it is impossible to determine its identity. It is easy to ascertain that a pasty mass in a bird's stomach is composed of scales partly digested, but to identify the species is quite another matter. The olive scale and others of its genus, on the other hand, are so large and their shells are of such structure that they can often be identified, at least generically, even from fragments.

While the San Jose scale was not positively determined, another species of the same genus, the greedy scale (*Aspidiotus rapax*), was found in 4 stomachs, and scales not specifically identified were found in 113. Of a total of 353 stomachs, 158 held scales; several were entirely filled with them, and in quite a number upwards of 90 percent of their contents consisted of these insects. No other family of insects was identified in so many stomachs. As it is certain that the

food contained in a bird's stomach at a given time is only a fraction of the daily consumption, we may infer that not many days pass in the life of a bush tit when it does not eat a considerable number of scales.

Before leaving the subject it may be well to add a few words on the economic relations of scale-insects in order that the value of the work done by the bush tit may be fully appreciated. Mr. Marlatt says:

> The most destructive insect enemies of fruits in California are undoubtedly the scale insects, few if any other insects, aside from the grape Phylloxera, at all approaching them in this respect. Of these, the ones of greatest moment and in the control of which vast sums of money are expended are the black scale, the red scale, and the San Jose scale. For the olive and citrus plants the black scale is the most important, and for the deciduous plants the San Jose scale takes similar rank.[a]

When the immense number of bush tits and other birds in California that eat scale insects is considered, it becomes evident that the aggregate of these pests annually destroyed by them must be enormous. It may be urged that despite the attacks of birds, scales have caused, and still are causing, much damage to fruit trees, and that the work of birds alone is inadequate to save the trees from destruction. This is undoubtedly true, but it must be remembered that the birds are confronted with abnormal conditions. The great and rapid development of the fruit-growing industry on the Pacific coast and the simultaneous and widespread introduction of several new species of scales resulted in a sudden increase of these pests, while their enemies, the birds, enjoyed no such opportunities for increase. In time, no doubt, an equilibrium would have been reached, and birds would have played an important part in establishing this by exerting a constant and steady check upon the increase of scales. Unaided, however, their numbers are too few to cope with the insects which, under favorable conditions of climate and environment and unmolested by other natural insect enemies, multiply to countless myriads.

The remaining portion of the hemipterous food of the bush tit, over 31 per cent, is made up of plant-lice, tree-hoppers (Membracidæ), leaf-hoppers (Jassidæ), some jumping plant-lice (Psyllidæ), and a considerable number of false chinch bugs (*Nysius angustatus*), with a few lace-bugs (Tingitidæ). Of the plant-lice little need be said. As pests to vegetation their reputation is world-wide. No part of a plant is free from attack. They infest leaves, trunk, and roots, and some of their legions of species prey upon nearly every kind of land plant. They are a frequent element of the food of the tit, but as their

[a] Insect control in California, by C. L. Marlatt, U. S. Dept. of Agriculture, Yearbook, 1896, p. 220.

bodies are of the softest texture specific identification is not possible. Many of them, however, were determined to be of the species commonly called 'woolly aphides,' as their bodies are covered with a white cottony or woolly substance. Aphides were identified in 30 stomachs, but it is probable that they were contained in more, as a pasty mass that could only be called 'hemipterous remains' was of frequent occurrence. Leaf-hoppers were found in many stomachs, and appear to be favorite food. Tree-hoppers also are eaten to a considerable extent, and as their bodies are hard, like those of beetles, they are more easily recognized than plant-lice. The jumping plant-lice were found in a few stomachs, but were rather difficult to distinguish in the conglomeration of plant-lice and other soft-bodied insects. False chinch bugs were found in a number of stomachs from the southern part of the State. These, perhaps, were the best preserved of any of the insects, for in most cases they could be distinguished individually. Over 50 were taken from one stomach.

Next to the bug family, the favorite food of the bush tits seems to be beetles. They constitute somewhat over 10 percent of the year's food and attain their maximum in September, when they amount to a little more than 27 percent of the food. The fewest were taken in December—less than 1 percent—but in all the other months they were found to a moderate extent except in the one stomach taken in April, which contained none. Among them were species of the ladybug family (Coccinellidæ), which are useful insects, as they are mostly carnivorous and feed largely upon plant-lice. In order to ascertain just how much harm the tit does in devouring ladybugs, a separate account was kept, and it was found that the total amount eaten during the year was 2.4 percent of the whole food. Most of these insects were eaten in September and October, when the consumption amounted to 11 and 6 percent, respectively. These are the only decidedly useful insects eaten by the bush tit, and in view of their small number the subject may be dismissed without further comment. The other beetles taken were largely small leaf-beetles (Chrysomelidæ), all of which are harmful. With them were some small weevils (Rhynchophora), which feed upon seeds and other parts of plants, with a few scolytids that burrow under the bark of trees to their great injury.

Butterflies and moths (Lepidoptera), most of them in the larval form (caterpillars), are next to beetles in importance in the food of the bush tit. They are, however, far from being such favorite food as bugs. The total is a little more than 16 percent. They are fairly evenly distributed through the year, though in spring and early summer they are consumed to a somewhat larger extent than in fall and winter. The greatest consumption was in May, when they aggregated

nearly 69 percent. Lepidoptera in the adult form do not as a rule constitute an important part of the diet of birds, but, with the exception of the flycatchers, the titmice perhaps eat the most. The greater number consumed by these insects, however, are eaten as larvæ—caterpillars. A few, however, are eaten in the pupa state, and here the bush tit has a good record. In a number of stomachs were remains of the pupæ of the codling moth, one of the worst pests to the apple industry. This insect is protected from the attacks of birds by its peculiar mode of life. It passes the larval stage inside the apple. The adult moth flies mostly by night and hides during the day. When the larva is full grown it leaves the apple and seeks a place of concealment, such as a crevice in the bark of the tree, a crack in the trunk, or among rubbish on the ground, where it changes to a chrysalis. It is in this stage that the insect is most vulnerable to the attacks of birds, and as the whole family of titmice get most of their food by searching in just such places as those used for concealment by the larva, it is not surprising that they find and devour many of them.

The cocoons of certain tineid moths are a very constant, though not large, component of the food of the bush tit. The larvæ of many of the Tineina are leaf-miners, and therefore injurious when attacking economic plants.

Strangely enough, wasps and ants (Hymenoptera) are nearly absent from the food of this bird. The total amount for the year is less than 1½ percent. In view of the fact that ants are always crawling over the trunks and branches of trees, the very places where the tits feed, it seems strange that so few of them are eaten. Moreover, plant-lice always have ants in attendance upon them, and when tits eat so many plant-lice it is rather remarkable that they should not take some of the ants also, as do the smaller woodpeckers, whose food habits are in many respects so similar. In 353 stomachs only two ants were identified, one in the adult and one in the pupal stage, and these were in separate stomachs. In 17 other stomachs a few fragments of what probably were small wasps were found, which make up the total of the hymenopterous diet of the bush tit.

The remaining animal food of this bird, about 8 percent, is composed of various insects, such as a few flies, a few bits of grasshoppers, insects' eggs not further identified, with a considerable number of spiders. That the tits should not eat grasshoppers is not surprising, as these insects do not commonly infest trees where the birds feed, and as a rule they are rather large game for such small birds. The great bulk of the 8 percent, however, consists of spiders, which constitute a constant item of food in every month. Quite a number of pseudoscorpions also were found in the stomachs, but, owing to their minute size, the percentage is not very noticeable.

Vegetable food.—The vegetable food of the bush tit may be considered under two categories—fruit and miscellaneous matter. Fruit in some form was found in stomachs taken in the months from August to November, inclusive. The average amount eaten in those four months was a little less than 1 percent. It is represented in the stomachs by pulp and skins, which have not been further identified. The miscellaneous vegetable matter is composed of a few seeds, granules of poison oak (*Rhus diversiloba*), leaf galls, and rubbish. The seeds of poison oak are eaten by many birds, and so are distributed about the country, but, as a rule, they are too large to be swallowed by the tit, which contents itself with pecking off the wax surrounding the seed. This is identified in the stomachs by certain woody granules. A large portion of the vegetable food consists of small galls, apparently from leaves. They are eaten when first developed, when young and tender. As each of these probably contained an egg or grub, it is questionable if they should not be classed as animal food. The remainder of the vegetable matter is of such a nature that the only term which really describes it is 'rubbish.' It is probable that it is mostly taken accidentally along with other food, and perhaps should not be considered in the food category.

FOOD OF NESTLINGS.

Among the 353 stomachs of the bush tits whose food has been discussed was one brood of eight nestlings about ten days old. As these are the only nestlings collected, their food would merit attention, but examination shows it to be of unusual interest. The vegetable matter in these stomachs was only three-fourths of 1 percent and consisted of one seed and some rubbish. The animal matter comprised, approximately: Beetles 2, wasps 2, bugs 8, caterpillars and pupæ 80, and spiders 7 percent. The point of greatest interest, however, lies in the fact that every one of these stomachs contained pupæ of the codling moth, distributed as follows: Two stomachs contained 2 each, two contained 3 each, one contained 4, one 7, one 9, and one 11, making 41 in all, or an average of over 5 to each. The oak tree in which these birds were found was in a belt of timber along a creek, and just across the stream was a considerable area of neglected orchard. It is evident that the parent birds used this orchard as a foraging ground and did their best toward remedying the neglect of the owner. As with nestling birds feeding and digestion are almost continuous during the hours of daylight it follows that the above record would be several times repeated during a day's feeding. There were probably not less than a dozen nests of the bush tit (several were seen) along the border of this orchard, and if, as is probable, the occupants all did as good work as the ones

recorded it is evident that the birds must exert a powerful restrictive influence upon the increase of the codling moth, as well as other insects.

SUMMARY.

In a résumé of the food of the bush tit the most prominent points to be considered are the fact that four-fifths of its diet consists of insects and spiders, nearly all of which are harmful; that more than half of its animal food is limited to a single order of insects, Hemiptera; that it eats the particular families of this order which contain the worst of insect pests; that the vegetable contingent of the food is made up almost entirely of substances of no economic value. It is doubtful if more efficient checks upon the increase of many species of forest and orchard insects can be found than the titmice and other closely related species. Bush tits, therefore, are a valuable asset to the State of California and should be protected and encouraged in every possible way.

Following is a list of insects identified in the stomachs of bush tits:

COLEOPTERA.

Crepidodera helxines.
Diachus auratus.
Orthoperus sp.
Corticaria scissus.
Scymnus marginicollis.
Scymnus pallens.
Scymnus nanus.
Notoxus alamedæ.
Anthicus sp.
Apion vespertinum.
Deporaus glastinus.

HEMIPTERA.

Nysius angustatus.
Geocoris bullatus.
Saissetia oleæ.
Aspidiotus rapax.

LEPIDOPTERA.

Carpocapsa pomonella.

The following families of Hemiptera were identified:

Tingitidæ.
Capsidæ.
Membracidæ.
Jassidæ.
Psyllidæ.
Coccidæ.
Aphididæ.

KINGLETS.

Kinglets, like gnatcatchers and titmice, are small, active birds and spend most of their lives on trees. So nearly do the feeding habits of these diminutive arboreal species resemble each other that in winter it is not unusual to see companies of titmice, kinglets, creepers, and nuthatches all together, engaged in the same unending search for

food. When one notices how thoroughly each tree is inspected by dozens of pairs of keen, prying eyes, he is surprised that any insects or their eggs should survive to produce broods.

RUBY-CROWNED KINGLET.

(*Regulus calendula.*)

The ruby-crowned kinglet is known in California principally as a winter resident, though in some of the high mountains it remains through the summer and breeds. Its small size would prevent it from doing appreciable injury to fruit or grain were any to be had when it is in the fruit and grain raising regions.

As might be inferred from field observations, its diet consists almost entirely of insects and their eggs, and the number it destroys is beyond computation.

In investigating the food of the kinglet 294 stomachs were examined, all taken in California from September to April, inclusive. Only 1 stomach was collected in September, 5 in March, and 5 in April. The other included months are fairly well represented. The food consisted of 94 percent of animal matter and 6 percent of vegetable. It was made up of insects, spiders, and pseudoscorpions—minute creatures resembling microscopic lobsters—fruit, weed seeds, etc.

Animal food.—The animal food is quite evenly distributed through the season. The greatest amount, 100 percent, appeared in the first and last two months, and the least, 79 percent, in January. Hymenoptera, in the shape of wasps, and a few ants appear to be the favorite food, as they aggregate over 32 percent of the whole. The stomach taken in September contained none of them, but in every other month they are fairly well represented, and with but little variation until March, when there is a sudden increase, which continues in April. This is undoubtedly due to the increased numbers of these insects following the return of warm, dry weather, for the order is noted for its fondness for warmth and sunshine. Adverse criticism may be made upon this element of the kinglet's diet, as flying Hymenoptera are useful agents in the fertilization of flowers, and some species of plants are dependent upon them for the performance of this important function. The parasitic species of this order also were found to some extent in the food of the kinglet, and unquestionably many of these are decidedly useful.

In the food of the kinglet, bugs (Hemiptera) are next in importance. They constitute nearly 26 percent of the diet, and are found in greatest quantity in the first months of the bird's winter stay, in September and October, but gradually decrease till spring.

The following families of Hemiptera were recognized in the stomach contents: Assassin-bugs (Reduviidæ), lace-bugs (Tingitidæ), leaf-bugs (Capsidæ), leaf-hoppers (Jassidæ), tree-hoppers (Membracidæ), jumping plant-lice (Psyllidæ), plant-lice (Aphididæ), and scale-insects (Coccidæ). Stink-bugs (Pentatomidæ), which are the most universally eaten by birds of any Hemiptera, are entirely wanting. Evidently it was not lack of opportunity that prevented the kinglets from eating the last-named insects, for other birds collected at the same time and place had partaken of them freely. From the human point of view it is not strange that birds should reject them, for to us their odor is vile and their taste nauseous. It will be noticed that the Hemiptera selected by the kinglet are mostly species of small size, but happily they are the very ones that are the most harmful to the interests of man. The tree-hoppers, the leaf-hoppers, and the jumping plant-lice, when abundant, are pests, and often do great harm to trees and smaller plants, while the plant-lice and scale-insects are the worst scourges of the fruit grower—in fact, the prevalence of the latter has almost risen to the magnitude of a national peril. As has been before pointed out, it is these small and seemingly insignificant birds that most successfully attack and hold in check these insidious foes of horticulture.

Beetles of various families and species were eaten by the kinglet to the extent of 13 percent of the season's food. They belong to species that are more or less harmful, with the exception of a number of ladybirds (Coccinellidæ), which from their habit of feeding on plant-lice are eminently useful. The damage done by the destruction of these useful beetles, however, is small, since they aggregate less than 2 percent of the whole food. Singularly, nearly all were in stomachs obtained in February. In this month 8 percent of these beetles were eaten, while in no other month was so much as 2 percent taken. Another curious fact is that almost all of these belong to the genus Scymnus, which is made up of minute black creatures which one might think would pass unnoticed by birds. On the contrary, the small and insignificant individuals of this genus appear to be eaten much oftener than the larger and more showy species. While the eating of ladybugs by kinglets or other birds is to be deplored, it must be acknowledged that little harm is done so long as the numbers destroyed are as moderate as the above figures imply.

Of the harmful beetles eaten the weevils are perhaps the most interesting. One stomach contained 20 individuals, which seems a large meal in view of the size of the bird. Many of the weevils belong to the family of engravers (Scolytidæ), which live under the bark of trees and are forest pests. Another beetle found in many stomachs is *Notoxus alamedæ*, an insect that lives on trees, but which does no harm so far as known. One stomach contained the remains of

100 individuals of this species. Other beetles were found belonging to about a dozen families, all more or less injurious.

Lepidoptera, both larvæ (caterpillars) and adult forms (moths and butterflies) constitute only a small portion of the kinglet's diet. They were eaten sparingly in every month but one, but in all aggregate only 3 percent of the whole. While a few caterpillars were eaten, most of the lepidopterous food consisted of the minute cocoons of tineid moths, a family of immense size, wide distribution, and destructive habits. They are largely leaf-miners, and do much damage to the foliage of fruit and other trees. They are so small that even the little kinglet can eat a great many of them at a meal. In only 2 stomachs was anything found that resembled a grasshopper, and in both the quantity was small and the identification doubtful. Flies (Diptera) constitute nearly 17 percent of the diet, but are very unevenly distributed. The greatest amount in one month was in January, 35 percent, all of which was in 7 stomachs collected in the same place within three days. These 7 stomachs contained an average of 96 percent of dipterous remains. The birds evidently found a gathering of flies, probably dormant, and filled themselves almost exclusively with them. Another series of 4, taken at the same place in February, also had eaten flies to the extent of over 80 percent of the food. Spiders and pseudoscorpions amount to nearly 2 percent of the food, and are taken quite regularly through the season, though the greater number were eaten in October. These last are curious minute creatures, the various species of which live under stones, on the bark of trees, and in old books.

Vegetable food.—The vegetable food of the kinglets may be discussed under three heads—fruit, weed seeds, and miscellaneous vegetable matter. Fruit amounts to less than 1 percent of the food, principally elderberries (Sambucus). Weed seeds are present to the extent of a little more than one-tenth of 1 percent, and may therefore be dismissed without further comment. In the miscellaneous vegetable food two items include nearly the whole—seeds of poison oak and leaf galls—which together amount to somewhat more than 4 percent. The eating of the seeds of poison oak is not a commendable habit in any bird, for the seeds are not destroyed, but after the wax on the outside is digested are either passed through the intestine or disgorged, and so these harmful plants are disseminated. In many of the stomachs certain small round bodies were found that were diagnosed as 'leaf galls.' They appear to be galls in the early stage and are eaten while small and tender.

SUMMARY.

The foregoing discussion of the food of the ruby-crowned kinglet serves to confirm popular opinion with regard to this bird. As its

food consists so largely of insects and as these include so small a percentage of useful kinds, the kinglet must be classed as one of the most beneficial of birds. To the horticulturist it is especially valuable, as nearly all of its food is obtained from trees. With respect to the persistency with which it forages among trees, it differs conspicuously from such aboreal species as leave the trees in midsummer to feed upon grasshoppers.

WESTERN GOLDEN-CROWN KINGLET.

(*Regulus satrapa olivaceus.*)

Another kinglet, the western golden-crown, occurs sparingly in winter in some parts of California. Only 9 stomachs have been examined, but these in the nature of their contents are so similar to those of the ruby-crown that statements applicable to the latter are almost certain to apply as well to this species. No vegetable matter was found in any of the 9 stomachs, and the insects belong to the same orders and were taken in essentially the same proportions as by the other species.

Following is a list of beetles which were identified in the stomachs of the two kinglets:

Coccinella t. californica.
Adalia frigida.
Scymnus pallens.
Scymnus nebulosus.
Hesperobaenus abbreviatus.
Corticaria ferruginea.
Throscus sericeus.
Listrus interruptus.
Aphodius rufifrons.
Diachus auratus.
Crepidodera helxines.
Epitrix parvula.
Notoxus alamedæ.
Anthicus nitidulus.
Apion respertinum.
Pityophthorus pubipennis.

Beetles were identified as belonging to the following families:

Staphylinidæ.
Coccinellidæ.
Monotomidæ.
Lathridiidæ.
Elateridæ.
Throscidæ.
Lampyridæ.
Malachiidæ.
Scarabæidæ.
Chrysomelidæ.
Tenebrionidæ.
Anthicidæ.
Curculionidæ.
Scolytidæ.
Other Rhynchophora.

GNATCATCHERS.

(*Polioptila* spp.)

Gnatcatchers are small, active birds of modest colors and unobtrusive notes. While not conspicuous, they are none the less deserving of respect and consideration. No complaints have been made that these busy creatures ever injure fruit or other crops. Their food

is composed almost exclusively of insects, which they hunt with untiring energy from morning till night. Like the titmice and kinglets, gnatcatchers are fitted by nature to perform a service which larger species are unable to accomplish. There are hosts of minute insects, individually insignificant but collectively a pest, that are too small to be attacked by ordinary birds and are to be combated by man, if at all, only at great expense. It is to so deal with such pests that they may not unduly increase that these tiny birds would seem to be especially designed. Three species of gnatcatchers live within the limits of the State of California. Two of them, *Polioptila plumbea* and *P. californica*, are confined to the southern part, while the third, *P. cærulea obscura*, occurs locally throughout the State. The material for a thorough discussion of the food of these birds is unfortunately not at hand, but there is enough to show conclusively the nature of the work they are doing, and to enable us to assign them their proper rank among the friends and helpers of mankind.

The food of the gnatcatchers is remarkably constant in character throughout the year, varying but little from month to month. It is probable that these birds have a preference for a certain diet, and search till they find it.

Only 30 stomachs of *P. c. obscura* and the same number of *P. californica* have been examined, and their contents were so similar that they may be treated as from a single species.

Vegetable food.—Of the 60 stomachs three only contained any vegetable food whatever, and in only one did it amount to a respectable percentage. This one held 92 percent of seeds of some species of Rhus; another contained 8 percent of unknown seeds, and the third a few bits of rubbish, which amounted to only 2 percent of the whole contents. The total vegetable matter in the 60 stomachs aggregated less than 2 percent of the entire food.

Animal food.—The remainder of the food, over 98 percent, is made up of beetles, wasps, bugs, and caterpillars, with a few flies, grasshoppers, and spiders. Bugs (Hemiptera) constitute more than half of the whole food, 64 percent. These belong to the families of stink-bugs (Pentatomidæ), shield-bugs (Scutelleridæ), tree-hoppers (Membracidæ), leaf-hoppers (Jassidæ), and leaf-bugs (Capsidæ), with perhaps traces of several others. In one stomach were 20 percent of black olive scales (*Saissetia oleæ*). All of these are harmful to trees and other plants. Wasps and a few ants (Hymenoptera) are next in importance as an element of the gnatcatcher's food, and amount to over 16 percent of the whole. These birds, like the flycatchers, take much of their prey on the wing, and it is probable that wasps and small bees are captured in this way. Beetles of several families were eaten to the extent of over 7 percent of the food, but no decided

preference for any particular kind is indicated. The only decidedly useful insects in any of the stomachs were 2 ladybird beetles (*Coccinella t. californica*), which had been eaten by *P. californica*. As this beetle is very abundant in California it is not surprising that birds should eat a few of them. Caterpillars amount to about 5 percent of the diet of the gnatcatchers. Apparently they are not a favorite food. Other insects, such as a few flies and grasshoppers, with some spiders, aggregate 6 percent, and probably are makeshifts, eaten when nothing more palatable is at hand.

SUMMARY.

While the foregoing discussion of the food of the gnatcatchers is based upon a small amount of material, the agreement of the evidence renders it probable that a much larger quantity would not greatly change the results. This evidence confirms what has long been suspected, that the gnatcatchers are doing a useful work and should be carefully protected.

RUSSET-BACK THRUSH.

(*Hylocichla ustulata.*)

The russet-back thrush abounds in the region about San Francisco Bay and other parts of the humid coast belt. It remains in this part of the State from April to November, inclusive, and then moves farther south for the winter. Its favorite haunts are the bushes and trees bordering streams, and in these it nests and rears its young.

While the thrush is very fond of fruit its partiality for banks of streams keeps it from frequenting orchards when they are far from water. It is most troublesome during the cherry season, at the time when the young are in the nest. It might be inferred from this that the nestlings are fed on fruit, but such is not the case to any noticeable extent. The parent birds eat the fruit themselves, while the young, as is usual with nestlings, are fed mostly upon insects. The old birds eat some fruit throughout the season, but do not seem to attract much attention by their depredations on prunes and the later fruits. As the thrush, unlike the linnet, is one of the so-called 'soft-billed' birds, its attacks on fruit are limited to the thin-skinned varieties. Probably it can peck holes in ripe cherries; still it is as often seen on the ground pecking at fallen fruit as attacking the fruit on the trees. It thus probably confines its depredations upon the later fruits to such as have already been broken into by linnets or other stout-billed birds.

Be this as it may, the thrush is an efficient destroyer of insects, and during the eight months of its sojourn in the fruit region a little more than half of its food consists of harmful insects. In the

investigation of this bird's diet 157 stomachs were examined. The birds came from various points about San Francisco Bay, and on the coast from Monterey to Santa Cruz, except one migrant which was taken in the southern part of the State. Only 6 stomachs were collected in April, 5 in October, and 7 in November. In the remaining four months 139 were taken, and as they are fairly evenly distributed the results for these months may be looked upon as reasonably reliable. Examination of the food shows 52 percent of animal matter to 48 percent of vegetable.

Animal food.—The greatest quantity of animal food was eaten in the first and last parts of the season—in fact, the six stomachs collected in April contained no trace of vegetable food. The animal matter decreases in each month up to September, in which month only 17 percent was eaten. From this month it increases, and ends with 62 percent in November. Too much reliance should not be placed upon the latter figures, as they were obtained from entirely too few stomachs, and are likely to be modified by the examination of more material. The animal portion of the food is mostly insects and spiders, with some earthworms and sowbugs (Oniscus).

Useful beetles (Carabidæ, Coccinellidæ, etc.) amount to less than 3 percent of the food of the year. Most of them are eaten at the beginning of the season before other insects are common. Other beetles, all more or less harmful, constitute 11 percent of the year's food, and are eaten chiefly the first of the season, decreasing toward fall but with a slight increase at the end. They are pretty evenly distributed among the more common families, and no decided preference is evident for any. It is probable that the thrush eats any beetles that come in its way, and does not make special effort to find a particular kind.

Caterpillars form somewhat more than 8 percent of the food, and while they are eaten in every month of the thrush's stay, they are taken much more freely previous to August. During and after that month they cease to be an important element of the diet. The average consumption of the first four months of the season is a trifle over 15 percent. Ants and wasps (Hymenoptera), bugs (Hemiptera), flies (Diptera), and grasshoppers (Orthoptera) are eaten by the thrush, although little preference is shown for any one of these except for Hymenoptera in the shape of ants. These are eaten with remarkable regularity throughout the season, and form about 16 percent of the food. This is the largest insect element in the food of the thrush, and the regularity with which ants are eaten would seem to indicate that they are highly esteemed and especially sought for.

While these insects do not often make themselves pests by directly attacking fruits and crops, they aid and abet the work of other insects in a way which renders them as bad as the worst of those directly

attacking crops. Their habit of caring for and protecting plant-lice is too well known to require extended comment. They take possession also of the empty burrows of wood-boring larvæ and extend these galleries still farther into sound timber. They often throw up mounds on lawns and in gardens, where it is almost impossible to exterminate them. In houses they frequently are an intolerable nuisance, infesting the pantry and spoiling food. The species that are not offensive in these various ways are mostly of a neutral character in their economic relations, and their destruction by birds does neither good nor harm.

Hymenoptera, other than ants (mostly wasps), bugs, flies, and grasshoppers, with some spiders, amount altogether to 12 percent of the year's food, and appear very regularly through the season. Grasshoppers, however, are near being conspicuous by their absence, as remains were found in only 4 of the 157 stomachs. This is rather remarkable for a bird whose habits are so terrestrial as those of the thrush. The majority of ground-feeding birds and many arboreal species feed largely upon grasshoppers. In fact, there is no order of insects for which insectivorous birds in general show such a decided preference. The spiders eaten by the thrush belong largely to the order Phalangida, commonly known as 'harvest men' or 'daddy-long-legs.'

Vegetable food.—The vegetable food of the thrush consists practically of fruit either wild or cultivated. A few weed seeds were found in several stomachs, but they amount to only a trace. It is probable that the greatest harm done by this bird is to the cherry crop, though undoubtedly it eats the later fruits to some extent. In May and June the fruit eaten reaches 41 and 38 percent, respectively, and this probably represents the greatest injury which the bird does, as most of the fruit was the pulp and skins of cherries. From June onward seeds of blackberries and raspberries (Rubus) were frequently found in stomachs, but as these berries are both wild and cultivated it is impossible to tell how much came from gardens. One stomach taken in early June contained seeds of the twin berry (*Lonicera involucrata*). Seeds of the elderberry (Sambucus) were abundant in stomachs taken in the late summer and fall, and indicate that this fruit constitutes a very considerable portion of the vegetable diet of the thrush at that season. Besides these were seeds of the pepper tree, of Solanum (a weed), and one stomach contained fruit of the coffee berry (*Rhamnus californica*). A few seeds of poison oak were found in two or three stomachs. The greatest amount of fruit was eaten in September, and reaches a total of over 80 percent, but as the number of stomachs is not as great as could be desired the result can scarcely be considered final. Moreover, a large part of this was wild fruit.

FOOD OF YOUNG.

Among the stomachs examined were those of 25 nestlings taken in June and July. Their approximate ages and dates of capture are given in the following table:

Brood No.	Number of young.	Age (approximate).	Date of taking.
		Days.	
1	Three	2	June 8
2	Four.....	8	June 8
3	Three	4	June 15
4	Three	14	June 19
5	Three	4	July 21
6	Two	3	July 25
7	Two	14	June 13
8	Five	7	July 16

Taking the collection as a whole their stomachs contained 92.6 percent animal matter to 7.4 percent of vegetable. Caterpillars aggregate nearly 27 percent and were found in every stomach but 7. No other element was so abundant. Beetles collectively are next in importance, with 22 percent. Of these the useful Carabidæ amount to 7.7 percent and are very irregularly distributed. All the remainder are more or less harmful species. Bugs (Hemiptera) aggregate 13.8 percent. Five families of these were identified, viz., stink-bugs, leaf-hoppers, tree-hoppers, shield-bugs, and cicadas. Ants and a few other Hymenoptera amount to 12 percent, and spiders to exactly the same. These last were mostly harvest-men or daddy-long-legs (Phalangidæ). A few miscellaneous insects amount to 6 percent, which makes up the whole of the animal food. Four stomachs of the russet-back contained remains of grasshoppers and three of these were nestlings. Carabid beetles were eaten by the young birds to the extent of 7.7 percent, which is more than three times the amount eaten by the adults. This is rather singular, for most of these insects are very hard-shelled and not at all the kind of food usually selected for young birds. Another interesting point is that all were contained in the stomachs of broods Nos. 2, 4, and 5. None of the other nestlings' stomachs held a trace of them.

The vegetable food amounts to 6.8 percent of fruit, with less than 1 percent of two or three other things. The fruit was nearly all either blackberries or raspberries, which were found in 11 stomachs, with twin berries in 1. One seed of filaree and some rubbish made up the rest of the vegetable food.

While the above affords a general idea of the food of these nestlings as a whole, there are some differences in the food of the different broods, which may be worthy of notice. The stomachs of broods Nos. 1, 2, and 6 contained no vegetable matter, as was the case with one each of broods 3 and 5. Broods 4, 7, and 8 had all eaten vegetable food,

but more than four-fifths of the whole was contained in the stomachs of broods 7 and 8. The average percentage for these two broods was over 22 percent, or about three times that of the whole. Again, Hemiptera, in the stomachs of broods Nos. 1 to 7, inclusive, amount to an average of less than 4 percent, but in brood No. 8 the average per stomach is over 53 percent of the food. Spiders were found in nearly every stomach of broods 1 to 4, while the other four broods contained very few. These facts indicate that birds exercise comparatively little choice as to the exact nature of their food, but take that which is nearest to hand. With a brood of hungry young incessantly clamoring for supplies little opportunity is afforded the busy parents to select precisely the kind of insects best adapted to the wants of the young. Nature teaches that insect food and not vegetable is needed and the gaping mouths are filled with the nearest obtainable supply.

In addition to the examination of stomachs of nestling thrushes field observations were made on the feeding of the young by the parent birds. Two nests of this species in the town of Hayward, Cal., were observed during several days in June and July, 1901. Each nest was watched for two one-hour periods on as many days as possible, and the number of times that the young were fed was carefully noted.

It may be said, to begin with, that the stomachs of young birds are kept constantly full during the hours of daylight.

Nest No. 1 was situated on a tree on the bank of a small creek on the edge of an orchard. When first observed, there were three young in the nest, apparently about five days old. This nest was watched for one hour from 9.40 a. m. on June 30, and the young were fed six times, but, as both parent birds came to the nest once with food in their beaks and went away without feeding the young, it is probable that they were not quite satisfied as to the intentions of the observer. At 4.25 p. m. of the same day another hour was spent in watching the nest, and the young were fed 11 times. On July 1, beginning at 8.30 a. m., 7 feedings occurred in one hour. This nest was not again watched until July 3, at 8.40 a. m., when the young were fed 8 times during the hour. In the afternoon of the same day, beginning at 3 o'clock, 12 feedings were observed in one hour. The last observation of this nest was made on July 5, beginning at 9 a. m. In an hour 13 visits with food were noted. In the case of this brood there were 57 feedings in six hours, or an average of 9½ feedings per hour. As there were three young, each one must have been fed a little more than three times per hour.

Nest No. 2 also contained three young, but they were only about 2 days old when first visited. The first observation was on June 30,

at 3.20 p. m., and the following hour the young were fed 8 times, and as the weather was cold the mother bird spent a number of minutes on the nest warming the nestlings. On July 1 another hour was spent in watching the nest, beginning at 9.30 a. m., and only 4 feedings were observed. It was, however, a cold, windy morning, and one or other of the parent birds remained on the nest all the time, leaving only when the mate brought food and took its turn brooding. The necessity for keeping the nestlings warm evidently prevented the parents from feeding them as often as customary. On the morning of July 3, although the weather was still rather cool, the birds seemed to be making up for the scanty feeding of the previous days, for they were observed to feed the young 15 times in an hour, beginning at 9.40 a. m., although they still took turns in warming the young for a few minutes at a time. In the afternoon of the same day, beginning at 4 o'clock, 8 feedings were noted in an hour. On July 5, beginning at 10 a. m., the parents were seen to feed the nestlings no fewer than 18 times, although one of them spent several minutes upon the nest three times during the hour. In the afternoon of that day 11 feedings were noted, in the hour beginning at 3.30, and 3 times one of the parents brooded the young, remaining once for six minutes. The next observation on this nest was made on July 6, during the hour from 7.50 a. m., and 12 feedings were noted. On July 7 the last observation was made, beginning at 3.20 p. m., and 11 feedings were noted. In this case there were 87 feedings in eight hours, or an average of nearly 11 per hour.

Considering both nests together, as each had the same number of young, we have 144 feedings in fourteen hours. Now at this time of year there are just about fourteen hours of available daylight, so that 144 feedings may be considered as an average day's work for a pair of parent birds, and as signifying the destruction of at least 144 insects, probably several times that number. Each of the three young must have been fed 48 times, which means that each stomach was filled to its full capacity several times during the day, another illustration of the fact that the digestion and assimilation of birds, especially of young ones, is constant and very rapid. This is further shown by the fact that when attempts have been made to raise young birds the experiments in most cases have failed because the nestlings were not fed often enough and actually starved to death. Young birds thrive best when fed a small quantity of food at short intervals rather than greater quantities at longer periods.

SUMMARY.

From the foregoing it appears that although this thrush eats considerable fruit it is not a pest to the fruit grower. Cherries seem to

be the only kind eaten to any considerable extent, and in the later summer wild fruit forms a large part of its vegetable diet. This thrush does not aid in the destruction of the seeds of noxious weeds.

In its insect diet the russet-back thrush is almost wholly beneficial, as it eats but few predaceous beetles or other useful insects. As young thrushes are fed almost exclusively upon insects, and as they eat almost continuously from morning till night, they must destroy an enormous number of these harmful creatures. From our present knowledge of its food and general habits, the russet-back thrush must be considered as one of our positively beneficial birds.

HERMIT THRUSH.

(*Hylocichla guttata.*)

The hermit thrush occurs in the valley and foothill parts of California only as a winter visitant. Thus it can destroy no fruit, except perhaps olives, and thus far no complaints have been made against the species in this respect. Although the bird has not yet attracted attention by depredations upon fruit, it may be well, nevertheless, to glance at its food habits as indicated by the contents of 68 stomachs. These were mostly taken in or about the Bay region, while a few came from the southern part of the State. Examination of the contents of these stomachs shows animal matter to the extent of 56 percent and vegetable 44 percent. The proportion of the two elements varies little in the different months.

Animal food.—Hymenoptera, mostly ants, constitute the largest item of the insect food. They amount to 24 percent, and appear to be eaten regularly in every month. This record is better than that of the russet-back. Caterpillars come next in importance, and form 10 percent of the food. They seem to be eaten rather more freely in February and March than in other months, though they are taken at all times of year. Predatory beetles (Carabidæ) are noticeable by their absence, as only a few remains of them appear. Beetles of other families, all harmful species, form 11 percent of the food. Weevils, or snout-beetles (Rhynchophora), constitute more than two-thirds of these, which would seem to indicate that they are a favorite food. When we consider that the carabids live on the ground, and are the most abundant and most easily obtained of any of the common beetles, and note how few of them the hermit thrush eats, while on the other hand it eats many snout-beetles, which, living to a great extent on trees, are generally much more difficult to find, we are forced to the conclusion that the latter are a preferred food, and that they are purposely sought for. Other insects, with some spiders and a few miscellaneous articles of diet (Oniscus), amount to about 12

percent. As in the case of the russet-back thrush, one stomach of the hermit contained the bones of a salamander.

Vegetable food.—The vegetable food is made up of two principal components—fruit and seeds. The former amounts to 29 percent of the whole, and is composed of wild species, or of old fruit left on trees and vines. A few stomachs contained seeds of raspberries, which, of course, must have been old, dried-up fruit. Seeds of the pepper tree and mistletoe were the most abundant and, with some unidentifiable pulp and skins, make up the complement of fruit. The hermit thrush eats more seeds than the russet-back, but does not stand high as a weed destroyer. Seeds of all kinds amount to 14 percent of the food, but only a few are usually reckoned as weed seeds. The most abundant seed was poison oak (*Rhus diversiloba*), which was found in a number of stomachs. While this plant is not usually classed among weeds, it is really a weed of the worst description, since it is out of place no matter where it is. It is unfortunate that birds in eating the seeds of this plant do not destroy them, but only aid in their dissemination.

SUMMARY.

On the whole, the food of the hermit thrush is remarkably free from useful products, destruction of which is a loss to mankind. The worst that can be said of the bird is that it eats and scatters the seed of poison oak, but it does not do this to a marked degree.

WESTERN ROBIN.

(*Merula migratoria propinqua.*)

In most of the valleys of California the robin is a winter resident only, and would be of little economic importance did it not possess a voracious appetite, the satisfaction of which occasionally leads to lamentable results. Of its summer food we know almost nothing, except what may be inferred from its list of edibles while in the valleys, and by comparison with the diet of its eastern relative. The two birds are so nearly alike that probably in the same environment they would eat practically the same things.

In investigating the food of the western robin 74 stomachs were examined. They were taken in every month from September to June, inclusive, except May. This number is entirely too small to be used as a basis for final conclusions, but it suffices to give a hint as to the differences, if any there be, between the food of the eastern and western races. Only one stomach was taken in each of the months of September, October, and June. The others are well distributed through the remaining months. Discarding returns from the three

months mentioned, 71 stomachs remain, from which a fairly reliable idea of the winter food of the robin in California may be obtained.

In the first examination we find 40 percent of animal food to 60 of vegetable. The food of eastern robins for the whole year contains 42 percent of animal matter to 58 percent of vegetable, and during the six months beginning on November 1 the amounts are: Animal 35 percent and vegetable 65 percent. If, however, our study is restricted to the three winter months, we find that the eastern robin eats 18 percent of animal food and 82 percent of vegetable, while for the same period the western one consumes 22 percent animal and 78 percent vegetable. These comparisons do not indicate essential differences in the food of the two birds. The western bird eats more insects during the winter months because on the west coast insects are more abundant and more easily obtained at that season than in the East. Confining attention, however, to the six months beginning with November, the eastern bird eats a greater percentage of insects. It is almost certain that if the material were at hand to illustrate the food of the western robin during the remainder of the year, the bird would be found to eat a much larger percentage of insects than in the six months covered by this investigation.

Animal food.—Beetles of various families are the largest item of animal food. The greater number were eaten in April, when they amount to over 54 percent of the whole food for the month. They were distributed among several families, but the most conspicuous were the snout-beetles, or weevils, which aggregated 25 percent. This is a favorable showing for the robin, for these beetles are among the most harmful insects with which the fruit growers and farmers have to contend. The average percentage of beetles for the whole six months is about 13 percent of the food. Caterpillars are next in order of abundance and amount to over 4 percent. The remainder of the animal food is made up of various insects, of which no order claims preeminence, and of a few angleworms.

Vegetable food.—The bulk of the vegetable food from November onward is cultivated fruit. After this month it gradually falls off, and very little was found in stomachs collected in March and April. With the exception of olives, the bird can obtain no fruit of value after the 1st of November, and as olives were not identified in any of the stomachs it is probable that most of the fruit consumed was worthless, having been left after the crop was gathered. The following fruits were identified: Grapes in 5 stomachs, figs in 3, prunes in 2, pear, apple, and blackberries in 1 each. Of wild fruit, pepper berries were found in 17 stomachs, mistletoe berries in 2, and fruit not positively identified in 11. Pepper berries evidently are the favorite, since not only were they found in the greater number of stomachs, but 1 stomach contained 24 and another 28 of these berries. Two

stomachs contained wheat and 3 had weed seeds, but dry seeds are evidently not favorite food with the robin.

Destruction of olives.—From the foregoing the robin would not appear to do much damage, or at least not more than is amply paid for by the insects it destroys. But, unfortunately, more is to be said about its food habits, which does not redound so much to its credit. In certain years when their customary food is scarce, robins appear in the valleys in immense numbers, and wherever there are olives they eat them so eagerly and persistently that the loss is often serious and occasionally disastrous. Sometimes, indeed, it is only by the most strenuous efforts, with considerable outlay of labor and money, that any part of the crop can be saved. Fortunately, such extensive damage is not done every year, although here and there the olive crop may suffer.

There is probably no more striking example of exceptional and intermittent damage to fruit by birds than an instance which occurred in the winter of 1900–1901. In that year the olive orchards in various parts of California were invaded by immense numbers of robins, which ate the fruit and in some instances destroyed the whole crop. In orchards where persistent effort was made to destroy and drive them away they still ruined from one-fourth to one-half of the yield. Olive orchards in Santa Clara Valley especially were afflicted. Mr. Paul Masson, who owns two orchards near Saratoga, as quoted by the San Jose Mercury of January 17, 1901, says:

> In my largest orchard of about 500 trees adjoining a larger orchard of about 50 acres on the El Quito farm, which is owned by E. E. Goodrich, are thousands of robins, which are destroying all the fruit on the trees. About two months ago I estimated that my trees would yield about 4 tons of olives, but Sunday, when I visited my orchard, I found the fruit would not be worth picking.
>
> I killed some of the robins, and upon examination found as many as five or six whole olives in the crop of each bird. Besides those which the bird had swallowed whole, many olives are pecked so that they are spoiled for market. Sunday there were not less than 50,000 robins on my place, and they are equally as plentiful on El Quito farm.

Mr. Edward E. Goodrich, the owner of El Quito farm and olive orchard, quoted by the same authority, says:

> The so-called robin is a destructive pest to an olive orchard. A crop can not be saved when the migration of the robin corresponds exactly with the maturity of the olive, as it does this year, except by immediate picking, which is practically impossible, or by shooting so constantly as to prevent steady consumption. * * * In 1898 my crop was 130 tons, and should have made about 4,000 gallons of oil. Owing to the lack of rain the result was about 2,750 gallons, of the value of $11,000. Now, that crop could have been wiped out in ten days by robins if they had been here as they were this season and no shooting had been done. So far as my foreman could estimate, before the birds descended upon the place, he placed the crop at a probable 3,000 gallons, which means when sold from $12,000 to $16,000, according to prices, and that would have been utterly destroyed but for the constant shooting the last ten days.

As it was, Mr. Goodrich placed his loss on the olive crop through the devastations of the robins at 25 percent of the whole, or about $5,000, while his foreman, in an interview with the writer, estimated the loss at 50 percent. He stated also that robins were so numerous that he killed 7 in a tree at a single shot.

The San Jose Mercury also states:

A representative of the Mercury visited the El Quito olive orchard to see what the facts were in this matter. He found a force of men picking the fruit as rapidly as possible, and he also saw thousands upon thousands of robins doing the same thing. On his way out he occasionally saw a single bird on the fence or in a prune tree, but when he reached El Quito the sky was streaked with robins flitting about and having a gala time of it. Men were scattered about through the orchard with guns, and every few minutes the report of one of these would set the robins to flying, but in an instant they would settle down again and resume their feast.

Hon. Ellwood Cooper, of Santa Barbara, one of the largest olive growers on the Pacific coast, in a letter dated January 25, 1901, says:

The robin is a terrible pest to olives. The birds do not always appear to come to the coast. My first experience was some fifteen years ago. The olives were late in ripening. I was as late as March making oil. The robins appeared to come in by the thousands. My last orchard that year was about one-half mile in length. The pickers were at one end. I had a man with a gun at the other, but they would attack the middle, and when the gunner would reach them they would fly to the end he left. This year they have been particularly bad. My boys reported that the birds, mostly robins, picked more olives than they could. The foreman of the pickers told me that he had knocked from a tree one-quarter of a sack and went to dinner; when he returned not an olive was on the ground. I know that on the ground in one orchard where the rain had caused to fall as many olives as would fill a bushel basket, in a week not one would be seen. The robins do not seem to be able to pick the olives so rapidly from the trees, but peck at those that are commencing to dry, knock them to the ground, then get them. The birds at this writing are in all my orchards by the thousands. They do not appear every year. It has been my theory that the native berries in the Sierra some years are not in sufficient quantities for food.

In the last sentence Mr. Cooper has probably suggested the true cause of the trouble. There is a crop of olives every year and the number of robins fluctuates little, but they rarely attack olives because usually their native food abounds. Where this fails the hungry birds shift about until they find a substitute.

SUMMARY.

With the exception of such sporadic cases as the above, the food habits of the robin are for the most part of a beneficial, or at least harmless, character. In the eastern part of the country very little damage by the robin is reported, though it is one of the most abundant species. This is probably largely owing to the plentifulness of wild fruits throughout the season. The trouble in California is that the robins from an extensive region concentrate into a comparatively

small area and, finding an abundant supply of palatable food, feed upon olives to the exclusion of all other food.

Were the hills and canyons of California as well supplied with wild berries as are the corresponding places in the Appalachian region, it is doubtful if such devastations of the olive crop would ever occur.

Since failure of the natural food supply of the robin is only occasional and can not be anticipated in advance, no direct safeguards against the bird's inroads are possible, though the planting of pepper and other berry-bearing trees about the orchards would materially aid in protecting the olive crop. The prompt and unsparing use of the shotgun when the emergency occurs, even though it seems to be the only practicable method to save the crop, is much to be deprecated, since the destruction of robins, which in the main are useful birds, is a loss to the community.

WESTERN BLUEBIRD.

(*Sialia mexicanus occidentalis.*)

The western bluebird has the same gentle, quiet demeanor that characterizes its relative of the Eastern States. It has not yet, perhaps, become quite so domestic as that species, but still is much inclined to frequent orchards and the vicinity of farm buildings. While the eastern bluebird usually nests either in a hole of an orchard tree or in the box specially provided for its use, the western species has not yet fully abandoned its habit of utilizing forest trees as nesting sites, and often may be found in lonely canyons or among the hills far from the abodes of man. The orchards of California as yet are hardly old enough to offer many hollow trees as nesting places of the kind so dear to the heart of our gentle friend. There is no reasonable doubt that in time the western species will become as domestic as the eastern one. A nest was found by the writer in a hollow tree in the home orchard of a ranch, only a few rods from the house. It contained six young, which would indicate that the bird is a prolific breeder, in this respect also resembling the eastern species.

The western bluebird is less migratory than the eastern and does not entirely desert the United States in winter; so its good work is continuous. As insects are active in California in every month the bird is able to support life even if there is no other food. Moreover, the insects eaten in winter count more in the reduction of these pests than do those taken after the spring broods are out. Insects that live through the winter are the stock by which the species is perpetuated, and the destruction of a few at this time is equivalent to the death in summer of hundreds or thousands.

The food of the bluebird consists of elements whose consumption is almost wholly a benefit to the farmer. Four-fifths of it is insects; only a small portion of these are useful, and these to a limited extent.

In the investigation of the food of the bluebird 187 stomachs were examined. This number is not so large as could be desired, and, moreover, was rather irregularly distributed over the year. Only one stomach was obtained in May, and only one in April, while the number for several other months are too few. Geographically they fairly well represent the fruit-growing regions of the State from as far south as San Bernardino northward to Santa Rosa. The food found in the stomachs consists of animal matter, 82 percent; vegetable, 18 percent.

Animal food.—Of the animal portion a little less than 12 percent consists of predaceous beetles (Carabidæ), which are usually reckoned as useful. There are, however, many exceptions to this rule, and since most of the species of this family are wonderfully abundant it is not probable that the bluebird does much harm by eating them. It is believed, moreover, that this record of Carabidæ is above the nornial, for the one bird taken in April had eaten 90 percent of these beetles, thereby raising the average of the whole. In August, on the other hand, not one of the five birds examined had eaten a carabid. Had these months been omitted from the reckoning the average would have been reduced to about one-third of the present figure, which is probably much nearer the truth.

Other beetles amount to over 17 percent of the food, and were distributed among about a dozen families, all of them harmful, except three or four ladybirds (Coccinellidæ), which are useful.

Caterpillars evidently are a favorite food, and probably are eaten in every month, though evidence is wanting for April and May. They amount to over 17 percent of the year's food. Few of these insects are eaten in spring and early summer, many in fall and winter. As practically all caterpillars are harmful, this item of diet counts entirely in the bird's favor.

Grasshoppers and crickets, mostly the former, were eaten in every month except April, but a greater number of stomachs would probably give a different result. They amount to a little less than 24 percent of the year's food. They appear in the stomachs of western birds at a somewhat earlier date than in those of eastern species. In the Atlantic and Central States, August is preeminently the season of grasshoppers, and in that month they constitute the principal article of diet of many species of birds. The western bluebird eats grasshoppers in March to the extent of about 11 percent of its food. In June they amount to over 38 percent, and in July reach a maximum of nearly 49 percent, or nearly half of all that it eats. In September they amount to 40 percent, but decrease rapidly from that time.

Bees and wasps (Hymenoptera) are not largely eaten by the bluebird, and flies scarcely at all, as the aggregate for the year amounts to only four-tenths of 1 percent.

In the summer bugs (Hemiptera) are eaten to a moderate extent. The species belong mostly to the family of 'soldier bugs' (Pentatomidæ) or, as they are sometimes called, 'stink-bugs,' for they have a vile odor and when taken into the mouth with a berry are not agreeable to human taste. The total percentage of wasps, flies, bugs, and a few other insects is a little less than 10 percent of the whole food.

Spiders are eaten to some extent throughout the year, but never in great numbers. The greatest number are taken in February, about 6 percent. The total average for the year is 2 percent. One stomach contained the lingual ribbon of a snail.

Vegetable food.—The bluebird asks practically nothing of man in the way of vegetable food. It is evident that it is not a lover of seeds, as is the linnet, and with abundance of them at hand, eats few or none. In 2 stomachs several small unknown seeds were found, which may have been swallowed accidentally. Not a kernel of grain had been eaten. Fruit constitutes nearly the whole vegetable portion of the food, and was distributed as follows: Elderberries (Sambucus) in 19 stomachs; grapes in 12 stomachs, all in the month of October or later; blackberries or raspberries (Rubus) identified in 4 stomachs; pepper fruits in 2 stomachs; figs in 1 and mistletoe berries in 1. Besides these 9 stomachs contained pulp or skins that could be identified only as fruit. From this it appears that elderberries are the favorite fruit of the bluebird. Fortunately these are nearly always to be had in California. Most of the grapes eaten probably were waste fruit, as many of them were consumed in December and other winter months.

FOOD OF YOUNG.

Among the stomachs examined were those of several nestlings about a week old. They were of interest as showing how large a proportion of animal food is given to the young. In one brood of six the only vegetable food found was a single piece of plant stem, which was probably given accidentally with other food, and should properly be classed as rubbish. The real food consists of grasshoppers and crickets 90 percent, beetles 3 percent, and the remainder made up of bugs, caterpillars, and spiders. In another brood of four, grasshoppers and crickets constituted 97.5 percent of the food, and 1 stomach contained nothing else. The remains of 11 grasshoppers were found in one of these stomachs, and 10 grasshoppers, a cricket, and a beetle in another. The only vegetable matter found in these 4 stomachs was a single seed of Polygonum.

Besides the stomachs of the western bluebird discussed above, 14

stomachs of the Arctic bluebird (*Sialia arctica*) were obtained. They were taken in fall and winter, and, while so small a number is not sufficient for positive conclusions, it may be said that the character of the food closely resembles that of the other species in the same months.

The two species eat about the same proportion of animal and vegetable food; the animal part consists of the same orders of insects, while the vegetable part is made up of the same varieties of fruit. In short, it may be said that if there are important differences in the food habits of the two birds the evidence at hand fails to establish the fact.

SUMMARY.

It seems scarcely necessary to comment on the foregoing statements with regard to the bluebird's diet in its economic relations. That the bird is an eminently useful species is so patent that it hardly needs to be pointed out. Whatever harm fruit growers have suffered from birds, none of it can be laid at the door of the bluebird.

List of insects identified in stomachs of bluebirds:

COLEOPTERA.

Coccinella t. californica.
Hippodamia convergens.
Polycaon stantii.
Aphodius rugifrons.
Blapstinus dilatatus.
Blapstinus sulcatus.
Blapstinus pulverulentus.
Rhigopsis effracta.
Balaninus sp.
Sitones sp.

HEMIPTERA.

Saissetia oleæ.
Sinea diadema.

HYMENOPTERA.

Messor andrei (ant).

Insects also were identified as belonging to the following families:

COLEOPTERA.

Carabidæ.
Staphylinidæ.
Coccinellidæ.
Histeridæ.
Elateridæ.
Buprestidæ.
Lampyridæ.
Ptinidæ.
Scarabæidæ.
Cerambycidæ.
Chrysomelidæ.
Tenebrionidæ.
Rhynchophora (superfamily).

HEMIPTERA.

Reduviidæ.
Capsidæ.
Lygæidæ.
Pentatomidæ.
Corimelænidæ.
Scutelleridæ.
Jassidæ.
Coccidæ.

O

Issued August 8, 1910.

U. S. DEPARTMENT OF AGRICULTURE

BIOLOGICAL SURVEY—BULLETIN No. 34

C. HART MERRIAM, *Chief*

BIRDS OF CALIFORNIA

IN RELATION TO THE FRUIT INDUSTRY

PART II

By F. E. L. BEAL

Assistant, Biological Survey

WASHINGTON

GOVERNMENT PRINTING OFFICE

1910

Issued August 8, 1910.

U. S. DEPARTMENT OF AGRICULTURE

BIOLOGICAL SURVEY—BULLETIN No. 34

C. HART MERRIAM, *Chief*

BIRDS OF CALIFORNIA

IN RELATION TO THE FRUIT INDUSTRY

PART II

By F. E. L. BEAL

Assistant, Biological Survey

WASHINGTON

GOVERNMENT PRINTING OFFICE

1910

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BIOLOGICAL SURVEY,
Washington, D. C., February 25, 1910.

SIR: I have the honor to transmit herewith for publication as Bulletin No. 34 of the Biological Survey, Part II of the Birds of California in Relation to the Fruit Industry, by Prof. F. E. L. Beal. This, the final part of the report, treats of some of the most important California birds from the standpoint of the orchardist and the farmer. Careful study of the food habits of birds that frequent orchards and their vicinity shows that most of the species are beneficial, and that without their aid the difficulty and expense of raising fruit would be enormously increased; still a few species under certain circumstances are harmful and need to be held in check.

Respectfully,

C. HART MERRIAM,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

BIRDS OF CALIFORNIA IN RELATION TO THE FRUIT INDUSTRY—PART II.

INTRODUCTION.

The first part of the report on Birds of California in Relation to the Fruit Industry was published in 1907. In addition to the linnet or house finch, which has attracted wide attention and is the subject of much complaint, 37 other species were discussed. In the present and concluding part, the food habits of 32 additional species are treated. Among them are some of the most important birds of the State, regarded from the standpoint of the farmer and fruit grower. The aim has been to collect all data possible on the food of the several species, to consider the facts impartially, and to render a just verdict as to the birds' economic relations.

All the birds whose food habits are discussed have direct relations with husbandry. It is true that many of them have not been charged with the destruction or injury of fruit or any other farm products. Almost all, however, destroy great numbers of harmful insects or devour seeds of noxious weeds; hence they are important economically.

A large part of the present report consists of statements concerning the food actually found in the stomachs of the birds. In this connection it should be borne in mind that by far the greater number of stomachs used in this investigation were collected in the more thickly settled and highly cultivated parts of the State, so that they probably contain a larger proportion of the products of husbandry than would a series of stomachs taken at random from all parts of the range of each species. It goes without saying that fruit and grain can be eaten only by such birds as have access to those products, while birds living in uncultivated places must subsist upon the fruits of nature.

Some California birds show a marked preference for oats, but in this State the presence of oats in a bird's stomach does not necessarily indicate that cultivated oats have been eaten, for wild oats cover hundreds of thousands of acres, and in the cultivated areas grow almost everywhere, affording a supply of food for many birds. Besides wild oats, the crop of volunteer oats that succeeds the cultivated crop is abundant and is to be found wherever this grain is

grown. In fact, in California the eating of oats can not as a rule be counted against a bird.

In no State in the Union is an accurate knowledge of the relations of birds to agriculture more important than in California. Climate and soil combine to make California an important grain and fruit producing State. The acreage already devoted to agriculture is large and is likely to increase for decades to come, as population increases and as new cultural methods are developed and irrigation is extended. Insects that now attract little attention are likely to increase and become serious pests. Certain birds formerly accustomed to a diet consisting partly of wild fruits, the supply of which is limited and likely to become smaller, will probably invade orchards and injure cultivated fruit. Hence it is worth while for the farmer and orchardist to learn as much as possible of the food of the birds that harbor near his premises, that he may know how much good each species does and how much harm, and so be enabled to strike a fair balance.

Some birds, like the swallows, swifts, wrens, and chickadees, are so strictly insectivorous that they are exceedingly beneficial. All they require at the hands of man in return for their services is protection. Others at some time of the year injure crops, though the damage by many is exceedingly small. Be the loss what it may, however, if a given species by its insectivorous habits prevents much greater destruction than it inflicts, the farmer should be willing to bear the loss for the sake of the greater gain.

Few birds are always and everywhere so seriously destructive that their extermination can be urged on sound economic principles. Only four of the species common in California can be regarded as of doubtful utility: These are the linnet, California jay, Steller jay, and redbreasted sapsucker. When the known methods of protecting fruit have been exhausted, or can not be employed profitably, then a reasonable reduction of the numbers of the offending birds is permissible. But the more the food habits of birds are studied the more evident is the fact that with a normal distribution of species and a fair supply of natural food, the damage to agricultural products by birds is small compared with the benefit.

A reasonable way of viewing the relation of birds to the farmer is to consider birds as servants, employed to destroy weeds and insects. In return for this service they should be protected, and such as need it should receive a fair equivalent in the shape of fruit and small grain. Nothing can be more certain than that, except in a few cases, any farmer who is willing to pay the toll collected by birds for actual services rendered will be vastly benefited. In the long run, no part of the capital invested in farm or orchard is more certain to pay big interest than the small sum required for the care and protection of birds.

CALIFORNIA QUAIL.

(*Lophortyx californicus* and *vallicola.*)

The California quail (see frontispiece) is common and generally distributed over the State west of the Sierra, except at the higher altitudes, and is especially abundant in the fruit-raising sections. Like the bobwhite of the East, this quail never goes far from cover, and it delights to dwell on unimproved land where trees and chaparral alternate with small areas of open ground. In settled regions it is somewhat domestic in habits and soon becomes accustomed to living in orchards, gardens, and cultivated grounds. The writer has seen a female sitting upon her eggs in a garden within 30 feet of a house, between which and the nest carriages and foot passengers passed many times each day. In winter a covey frequently feeds with the farmer's chickens, and if not disturbed will continue to do so until pairing time.

The natural food of the quail consists of the seeds of that vast group of plants known as weeds, with a little foliage of the same, especially in winter, when the leaves are young and tender. Considering how small is the amount of fruit usually found in the stomach of this bird, it is a surprise to learn that it sometimes does serious damage to vineyards. Investigation, however, shows that, as in most other similar cases, the injury results only when too many birds gather in a limited area. Nearly all the complaints against the quail for eating fruit are that it visits vineyards in immense numbers and eats grapes. When thousands visit a vineyard, even if only occasionally, and each bird eats or spoils at least one grape, the result is disastrous.

Mrs. Florence Merriam Bailey, writing of the foothills of San Diego County, says:

> In 1889 quail were so numerous that the dust of the roads was printed with their tracks, and it was an everyday matter to have them start out of the brush and run ahead of the horses quite unconcernedly, pattering along in their stiff, prim way, with their topknots thrown forward over their beaks. In fact, the quail were so abundant as to be a pest. For several years great flocks of them came down the canyons to Major Merriam's vineyard, where they destroyed annually from 20 to 30 tons of fruit. In one season, July to October, 1891, 130 dozen were trapped on his ranch. The result of this wholesale destruction was manifest when I returned to the valley in 1894. The birds were then rarely seen on the roads and seldom flushed in riding about the valley.[a]

Another observer states that he once saw a flock of about a thousand quail eating Zinfandel grapes in a vineyard in the central part of the State, and another says that in southern California he has seen as many as 5,000 feeding upon Muscat grapes. In the writer's interviews with California fruit growers, only one mentioned the quail

[a] Auk, XIII, p. 116, 1896.

as harmful. His ranch was situated along the hills on the side of a narrow valley, adjacent to wild grazing land with much chaparral and forest, among which the quail lived. In this case the annual loss was estimated at 2 or 3 tons of grapes.

In the laboratory investigation of the food of the California quail 619 stomachs were examined. They were collected in every month except May, but only one was obtained in March. The other months are well represented. Animal food, principally insects, amounts to but 3 percent, and most of this was found in the stomachs of young birds, mere broodlings. Vegetable food amounts to 97 percent and consists mainly of seeds of plants most of which are of noxious or troublesome species.

Animal food.—Ants appear to be a favorite food. They were found in 82 stomachs, and were eaten by adults as well as by young. They amount, however, to less than 1 percent of the whole diet. The rest of the animal food aggregates a little more than 2 percent and is distributed as follows: Beetles in 30 stomachs, bugs (Hemiptera) in 38, caterpillars in 11, grasshoppers in 7, flies in 2, spiders in 6, millepeds in 1, and snails in 2. The most interesting point in this connection was the stomach of a broodling only 3 or 4 days old. Besides several adult Hemiptera, some ants, caterpillars, and spiders, and a few seeds, it contained 280 minute insects, which constituted 76 percent of the stomach's contents, and were identified as an immature form of a species of scale, *Phenacoccus helianthi.*

In this connection the following extract from a letter dated at Los Angeles, Calif., October 28, 1908, by Dr. W. G. Chambers, to the Secretary of Agriculture is interesting:

> Last May during the hatching season one of my female quail died a week prior to completing the hatch. An incandescent light of 8 candlepower was substituted, the result being 15 baby quail, very wild at first, not understanding human sounds or language, but finally becoming as docile as pet chickens. They were raised in my back yard, running at large after the first week.
>
> A number of Marguerite bushes which grow in profusion in the yard were so infested with black scale that I had decided to uproot them and had postponed doing so, as the little quail worked so persistently among the branches; upon investigation I discovered them eating the scale and twittering happily; they would swallow the fully developed scale and thoroughly clean the branches of all those undeveloped.

The young in the first week of life eat animal matter to the extent of from 50 to 75 percent of the food, but by the time they are 4 weeks old they take little if any more animal food than the adults.

Vegetable food.—The vegetable part of the quail's food may be divided into fruit, grain, seeds, and forage. Fruit appeared in 106 stomachs, and aggregates 2.3 percent of the yearly diet. It was distributed as follows: Grapes in 7 stomachs, prunes in 9, apple in 3, Rubus (blackberry or raspberry) in 4, olive in 1, elderberry in 21, snowberry in 8, manzanita in 2, huckleberry in 11, and rose-haws in 3.

Pulp and skins, identified as fruit only, were found in 27 stomachs, and unknown seeds, probably those of some small fruit or berry, occurred in 10 stomachs. It is evident that the percentage of any one of the above is insignificant. Stomach examination throws no new light upon the quail's grape-eating habits, except to show that the ravages complained of are exceptional. That fruit does not constitute any important part of the bird's annual food is clearly proved.

Grain was found in 133 stomachs, and constitutes 6.4 percent of the food. It was distributed as follows: Corn in 14 stomachs, wheat in 15, oats in 13, barley in 89, and rye in 2. The principal complaints against the quail on the score of grain eating are that flocks sometimes visit newly sown fields, and eat large quantities of the seed. Walter E. Bryant says on this point:

> Two males which I shot one evening, as they were going to roost for the night, after having been feeding on a newly sown field, contained the following, mainly in the crop: (*a*) Two hundred and ten whole grains of barley, 6 pieces of broken barley, 3 grains of 'cheat,' and 1 of wheat, besides a few barley hulls, some clover leaves, and alfilaria; (*b*) one hundred and eighty-five whole grains of barley, 5 broken pieces, 4 grains of 'cheat,' and 2 of wheat; also barley hulls, clover, and alfilaria. The flock numbered nearly or quite 20 birds.[a]

Only one report accuses the bird of eating grain from the harvest field. Mr. W. T. Craig, of San Francisco, writing to the United States Department of Agriculture, says:

> I have observed the quail enter a field of wheat to the number of thousands, and had they not been driven away they would have destroyed the whole crop.

Stomach examination does not indicate any month in which grain is eaten in excess of other food. January shows the highest percentage, 12.4, but November is nearly as high, while December, although between the two, shows less than 3 percent. A little more than 3 percent was eaten in February, and none at all in March and April, though the newly sown grain would be accessible in one at least of these months. June and July, the harvest months, show respectively 4.1 percent and 10.7 percent. In fact the stomach record plainly indicates that the quail does not make special search for grain, but being naturally a seed eater takes grain when it comes in the way.

The seeds of a multitude of plants which have no apparent useful function except to increase by their decay the deposit of humus in the soil constitute the staff of life of the quail. In this particular investigation they aggregate 62.5 percent of the food of the year. They appear in stomachs taken in every month and reach a good percentage in each, the only months that show much diminution in quantity being January, February, March, and April, when new forage partly replaces seeds. The percentage is highest in June, 85.9, but shows no great falling off from July to December inclusive.

[a] Zoe, IV, pp. 55–56, 1893–94.

Seventy-three kinds of seeds were identified, at least generically, and more than half of them were determined specifically. Many more were ground up so as to be unrecognizable. The following is a list of the seeds with the number of stomachs in which each kind occurred:

Poverty weed (*Iva axillaris*)	3
Gum weed (*Grindelia squarrosa*)	2
Bur marigold (*Bidens* sp.)	17
Sunflower (*Helianthus* sp.)	1
Tarweed (*Madia sativa*)	67
Mayweed (*Anthemis cotula*)	27
Milk thistle (*Silybum marianum*)	14
Thistle (*Cirsium* sp.)	5
Blessed thistle (*Cnicus benedictus*)	1
Bur thistle (*Centaurea melitensis*)	201
Sow thistle (*Sonchus asper*)	2
Sow thistle (*Sonchus oleraceus*)	1
Prickly lettuce (*Lactuca scariola*)	4
California dandelion (*Agoseris* sp.)	2
Blue vervain (*Verbena hastata*)	22
Stickseed (*Echinospermum* sp.)	16
Burweed (*Amsinckia tesselata*)	11
Ribwort (*Plantago lanceolata*)	2
Pursh ribwort (*Plantago purshi*)	1
Common plantain (*Plantago major*)	2
Painted cup (*Castilleia* sp.)	1
Black nightshade (*Solanum nigrum*)	10
Dodder (*Cuscuta* sp.)	3
Morning glory (*Convolvulus* sp.)	2
Pimpernel (*Anagallis* sp.)	2
Carrot (*Daucus carota*)	5
Lupine (*Lupinus* sp.)	150
Bur clover (*Medicago denticulata*)	156
Sweet clover (*Melilotus alba*)	6
Clover (*Trifolium* sp.)	75
Deer weed (*Lotus glaber*)	50
Vetch (*Vicia* sp.)	32
Five-finger (*Potentilla* sp.)	1
Turkey mullein (*Eremocarpus setigerus*)	168
Sumac (*Rhus laurina*)	69
Poison oak (*Rhus diversiloba*)	52
Alfilaria (*Erodium cicutarium*) Alfilaria (*Erodium moschatum*)	30
Carolina geranium (*Geranium carolinianum*) Common geranium (*Geranium dissectum*)	47
Wood sorrel (*Oxalis corniculata*)	1
Mallow (*Malva rotundifolia*)	11
Shepherd's purse (*Capsella bursapastoris*)	1
Peppergrass (*Lepidium* sp.)	5
Wild radish (*Raphanus sativus*)	5
Black mustard (*Brassica nigra*)	32
Wild turnip (*Brassica campestris*)	3
California poppy (*Eschscholtzia californica*)	1
Buttercup (*Ranunculus* sp.)	14

Water crowfoot (*Ranunculus aquatilis*)	3
Miner's lettuce (*Montia perfoliata*)	26
Red maids (*Calandrinia menziesi*)	58
Pigweed (*Chenopodium album*)	11
Rough pigweed (*Amaranthus retroflexus*)	77
Corn spurry (*Spergula arvensis*)	1
Common chickweed (*Stellaria media*)	62
Field chickweed (*Cerastium arvense*)	2
Sleepy catchfly (*Silene antirrhina*)	58
Black bindweed (*Polygonum convolvulus*)	1
Dotted smartweed (*Polygonum punctatum*)	2
Common knotweed (*Polygonum lapathifolium*)	2
Wire grass (*Polygonum aviculare*)	55
Curly dock (*Rumex crispus*)	9
Sorrel (*Rumex acetosella*)	59
Sedge (*Carex* sp.)	26
Galingale (*Cyperus* sp.)	7
Rag grass (*Lolium perenne*)	56
Soft brome (*Bromus hordeaceus*)	3
Cheat, or chess (*Bromus secalinus*)	18
Walk grass (*Poa annua*)	29
Timothy (*Phleum pratense*)	1
Bear grass (*Stipa setigera*)	5
Canary grass (*Phalaris caroliniana*)	2
Unidentified seeds, mostly ground up	293

From this list it would appear that bur thistle, lupines, bur clover, and turkey mullein are the favorite seeds; that the others are not distasteful is shown by the quantities found in some stomachs. For instance, mayweed was identified in only 27 stomachs, yet one stomach contained at least 2,000 of these seeds; pigweed (*Chenopodium*) in but 11, yet one contained 1,000. One stomach held 83 kernels of barley, 592 seeds of geranium, 560 of tarweed, 40 of bur thistle, 48 of clover, 80 of alfilaria, 704 of timothy, 32 of catchfly, and 5 of snowberry, or 2,144 seeds in all. Another contained 1,696 geranium seeds, 14 bur thistle, 24 knotweed, 14 tarweed, 38 bur clover, 148 alfilaria, 12 ray grass, and 1 unknown seed, and a pod of uncertain origin—in all 1,944 seeds and a pod. In both cases the contents of the crop is included with that of the stomach or gizzard. These samples indicate considerable variety in the quail's diet, even in one meal.

Grass and other forage constitute a little over 25 percent of the quail's annual food. Forage amounts to less than 1 percent in June, remains about the same until October, and increases somewhat in November. In January it becomes important, and it reaches nearly 60 percent of the food for the next four months. The maximum, 85 percent, occurs in March; but this percentage, based on only one stomach, can not be considered final. Seeds and forage are practically complementary to each other—that is, as one increases the other decreases. June, which shows the least forage, has the largest percentage of seeds. Leaves of red and of bur clover and of alfilaria were the

favorite kinds, and in some cases constituted the whole stomach contents. Blades of grass are frequently taken. A few bits of acorn, and perhaps other nuts, were eaten, but the quantity is insignificant.

SUMMARY.

From the above analysis of the food of the California quail, it is apparent that under normal conditions the farmer and fruit grower have nothing to fear from its ravages. When, however, large areas of chaparral land are cleared and brought under cultivation, it is natural that the products of garden and vineyard should be eaten to a greater or less extent by quail, which abound in such localities. On the other hand, its seed-eating record is greatly in its favor. Usually there is little difficulty in getting rid of a superfluity of game birds; in fact, in most cases the trouble is to prevent their extermination. A bird so large, so easily trapped, so valuable as food, and withal one whose pursuit affords such excellent sport as the valley quail, will probably not become numerous enough to do serious damage except locally and under unusual conditions, and then a reduction of numbers is the easiest and simplest cure. Permits to trap quail on one's own premises are obtainable in California on application to the State fish commissioner. After the birds have been sufficiently reduced, they can be kept within reasonable limits by a moderate amount of shooting in the proper season.

WOODPECKER FAMILY.

(Picidæ.)

Among the useful birds of the State few take higher rank than the woodpeckers. They are mainly arboreal, and most of them may be designated as conservators of the forest in the strictest sense. The larvæ of certain species of beetles and moths live either under the bark or within the solid wood of trees, where they are safe from the attacks of birds, except such as are furnished by nature with special tools for digging into wood and bark. In this respect our native woodpeckers are in general highly favored. The peculiar structure of their chisel-shaped beak, combined with sharp claws and a stiffened tail for support, enables them, when they have located their prey, to drill down to it through several inches of wood and draw it forth with their tongue. This latter organ, in the more typical species of the family, is long, cylindrical, and barbed at the tip, being particularly well adapted for probing the burrows of boring insects.

Twenty-one species and subspecies of woodpeckers occur in California. Of these about half a dozen are sufficiently abundant and widely distributed to be economically important. The average

amount of insect food in the stomachs of the six species discussed in the following pages is 62 percent of the whole contents.

It is unfortunate that the most valuable species of our woodpeckers are not abundant. In many parts of the country the downy and hairy woodpeckers are quite rare and, what is worse, appear to be diminishing in numbers. As they are among the most valuable of our species, it is worth while to inquire into the cause of their scarcity and if possible to devise efficient remedies. In most sections these birds can obtain an abundance of food, and as they are not persecuted, so far as known, the most probable cause for their scarcity would appear to be the lack of suitable nesting sites. This is especially true in the northeastern part of the United States where the war waged upon the gipsy and brown-tail moths has led to the trimming of all dead trunks and limbs from forests and orchards, so that the woodpeckers, which as a rule dig new nesting holes every year, are left with no places in which to nest. In Germany, after much experimentation, it has been found possible to construct nesting boxes which the European woodpeckers freely use. There can be no reasonable doubt that a similar result can be attained in this country. Pending experiments and as a step in the right direction, it would be well for orchardists to leave the stubs of dead limbs on orchard trees as sites for the nests of woodpeckers. While the woodpecker may use the nest it excavates only one season, the hole will be available for bluebirds, wrens, chickadees, and nuthatches in succeeding years. The experiment of inducing our woodpeckers, especially the downy and hairy, to build in artificially constructed nesting boxes is well worth patient and persistent experiment.

HAIRY WOODPECKER.

(*Dryobates villosus harrisi* and *hyloscopus*.)

Two subspecies of the hairy woodpecker occur in California, and between them they occupy nearly the whole State at some time of the year. Their favorite haunts are open groves and orchards, and as forests disappear and fruit trees increase in number, they will probably more and more inhabit orchards. That the hairy woodpecker is far from abundant at present is unfortunate, for its food habits make it of great economic importance. Only 27 stomachs have been examined, but the dates of collection are well distributed. Seven is the greatest number taken in any one month (September), and none at all were obtained in March, May, August, and October. While this number is sufficient to afford a general idea of the kind of food the bird prefers, it does not furnish reliable data as to the relative proportions of the different constituents.

Of the contents of the 27 stomachs, 78 percent consisted of animal matter, nearly all of which was either insects or spiders. The remaining 22 percent was made up of various vegetable substances. In the relative proportions of animal and vegetable food the California bird differs somewhat from the eastern subspecies, the diet of which consists of 68 percent of animal matter to 32 of vegetable.

Animal food.—Of the various items in the food of the western hairy woodpecker, the most important, as well as the largest, is the larvæ of wood-boring beetles (Cerambycidæ and Buprestidæ). These aggregate for the year nearly 49 percent of the total. This is a much greater proportion than is eaten by the eastern subspecies, and is probably not exceeded by any other bird. Each of several stomachs contained more than 20 larvæ. When the immense damage done by these borers to forest trees, as well as to orchards, is considered, it is hardly possible to overestimate the value of this woodpecker's services. Moreover, these insects are concealed and protected from the attacks of all birds except those of this family. Most of these insects are taken in the cooler months, the fewest being eaten in July. One stomach taken in February contained 70 percent of wood-borers, and the remainder, or 30 percent, consisted of other harmful beetles. Two stomachs taken in April contained an average of 76 percent of these destructive borers and 6 percent of other beetles. Beetles belonging to various families, nearly all of them harmful, and some very injurious, amount to over 9 percent of the food.

Ants are usually a favorite article of food with woodpeckers, but with the California hairy woodpeckers they constitute less than 3 percent of the year's food. This is somewhat surprising, as the eastern bird eats them to the extent of 17 percent. Other Hymenoptera, including wasps, amount to less than 2 percent.

Caterpillars exceed 11 percent, and stand next to beetles in importance. Many of them are of wood-boring species and evidently were dug out of trees.

A few miscellaneous insects and some spiders complete the animal food. Several stomachs contained segments of millepeds, or thousand legs, and one held the remains of one of those bristly creatures known as jointed spiders (Solpugidæ).

Vegetable food.—The vegetable part of the diet may be divided into fruit, seeds, and miscellaneous substances. Fruit amounts to 6 percent, and consists of the smaller kinds, probably mostly wild species. Rubus seeds (raspberry or blackberry), found in several stomachs, were the only fruits positively identified. Seeds aggregate nearly 12 percent, and all that were determined belonged to coniferous trees. The miscellaneous part contains a little mast and some cambium, or inner bark, but is mostly rubbish, such as rotten wood, probably swallowed accidentally with the beetle larvæ.

SUMMARY.

The above brief review of the food of the hairy woodpecker indicates that nearly half its yearly food consists of larvæ of some of the most destructive insects known, while this service is not offset by the destruction of any useful product. The other elements of the bird's food are either beneficial or neutral. It is unfortunate that the species is not more abundant on the Pacific coast.

DOWNY WOODPECKER.

(*Dryobates pubescens gairdneri* and other subspecies.)

To the ordinary observer the downy woodpecker is only a miniature edition of the hairy, which it resembles in everything but size. It seems, however, to be far more abundant than its larger relative, especially in California. It is much more domestic than the hairy, and frequents orchards and gardens and the vicinity of houses. Its food consists of the same elements but in different proportions. The following report is based on an examination of 80 stomachs, taken in every month of the year. The food consists of 77 percent of animal matter to 23 of vegetable, thus agreeing closely with the diet of the hairy.

Animal food.—The animal food is composed of insects, with a few spiders. The western downy eats 16 percent of wood-boring larvæ, a little more than the eastern downy, but less than one-third as much as the hairy woodpecker. Other beetles amount to 13 percent. They are mostly harmful species, the exception being a few Carabidæ, or predaceous ground beetles.

Ants are eaten to the extent of 12 percent, which is less than half the quantity taken by the eastern subspecies. While ants may sometimes subserve a useful purpose, they are for the most part annoying or noxious. It is well known that they protect and foster plant lice, and they often injure timber by boring galleries through it, frequently beginning in the abandoned burrow of a beetle larva. In houses they are an unmitigated nuisance, and in gardens and lawns are often equally obnoxious. For these reasons the habitual destruction of ants by woodpeckers is commendable. Other Hymenoptera amount to less than 2 percent, and consist of wasps and wild bees.

The largest item in the food of the downy is made up of caterpillars, pupæ, and a few adult moths. These aggregate a little over 21 percent. Pupæ of the codling moth were identified in 4 stomachs and the larvæ in 2, of which one contained 16 entire full-grown larvæ. Another held the remains of 20 of these pernicious insects. From investigations during the past few years it appears that birds constitute a most efficient natural check to the spread of this destructive moth, especially such birds as woodpeckers, titmice, nuthatches, and creepers, which obtain much of their food from crevices in the

bark of trees. It behooves the orchardist to see that these birds are carefully protected on his premises and encouraged in every possible way.

The Hemiptera, or bugs, which appear in the food of the downy woodpecker are plant lice and scales, with a few other forms. They amount to 10 percent of the year's food, but all were eaten in the seven months beginning with March, and averaged 17 percent for each of these months. Scales were found in 8 stomachs, and in one they constituted 83 percent of the contents. The black olive scale (*Saissetia oleæ*) was the only one identified. Plant lice were found in 11 stomachs, but none were specifically identified, although some were of the woolly species. That these are a favorite food is shown by the quantity eaten. Five stomachs contained the following percentages: 94, 94, 84, 81, and 80. These creatures are so fragile that the process of digestion soon destroys their shape, and it is highly probable that small numbers were contained in many more stomachs but were not identified.

Grasshoppers, although a favorite article of bird food, are entirely ignored by the downy woodpecker. This emphasizes the arboreal habits of this species, as most birds feed upon grasshoppers, when in season, in preference to their ordinary food. Flies also are practically absent from the diet of the downy. A few miscellaneous insects and spiders, amounting in all to 3 percent, make up the remainder of the animal food.

Vegetable food.—The vegetable part of the food may be arranged under three heads—fruit, seeds, and miscellaneous items. Fruit was found in 14 stomachs, and amounts to 9 percent of the food. Cherries were identified in a few stomachs, and apples, or a similar fruit, in several more; but most of the remains were skins of small berries not further identified. Evidently this bird does little or no damage to fruit. Seeds amount to a little more than 7 percent, and are mostly those of poison oak, which the downy, in common with many other birds, aids in disseminating. Grain (oats) was found in 2 stomachs. The miscellaneous vegetable food, 7 percent, consists of mast, or acorn meat, a little cambium, and rubbish.

Food of young.—A nest of young downies was watched for 12 one-hour periods during six days, and the number of feedings noted as follows:

Date.	Hours in forenoon.	Number of feedings.	Hours in afternoon.	Number of feedings.
June 7	9.16–10.16	12	4.23–5.23	13
June 8	8.01– 9.01	10	1.13–2.13	10
June 9	10.42–11.42	12	5.00–6.00	10
June 10	9.17–10.17	14	2.34–3.34	10
June 11	10.15–11.15	11	4.49–5.49	15
June 12	10.37–11.37	20	4.33–5.33	23

In the twelve hours during which the birds were watched, the nestlings were fed 160 times, an average of 13⅓ times per hour; or each of the 4 was fed more than three times per hour. The nest was in a stub of a cherry tree in a mixed orchard, and apparently all the foraging was done in the immediate vicinity, as food was brought too often to have been carried any great distance; moreover, the parent birds were frequently seen searching the trees. Both parents took part in caring for the young, one often waiting patiently near by while the other fed the nestlings. At first the parent birds entered the nest chamber when they came with food, but later, as the nestlings grew larger, they remained outside, thrusting their heads in at the opening. The food nearly always appeared as a white mass in the beak, which led to the suspicion that the young were being fed with woolly aphids. The parent birds came from the direction of a number of apple trees which were badly infested with this pest, and the bark of the trees showed places from which the insects had been recently taken. Thus it was practically certain that aphids were being fed to the young woodpeckers.

SUMMARY.

From the foregoing account it is evident that the downy woodpecker is of great value to the horticulturist. Its food consists largely of orchard pests, and its levies upon fruit are insignificant. The orchardist should note that the downy makes its nest in a chamber which it excavates in a partly rotten trunk or limb of moderate size, frequently of an apple tree. Where such wood occurs in or about the orchard, it should be left for the convenience of the woodpecker and his successors, the wrens and titmice. By so simple a precaution as this the number of downies and of other useful birds that build in holes may be materially increased in an orchard and their services secured without cost at the very point where most needed. When trimming dead limbs, it is necessary only to leave a few inches of the stub, which is not unsightly, and which answers all the purposes of the woodpecker.

NUTTALL WOODPECKER.

(Dryobates nuttalli.)

The Nuttall woodpecker is well distributed over California west of the Sierra Nevada, but is less abundant than the downy and not quite so domestic. It is rather more fond of big oaks and other forest trees than of the orchard, but is often found on fruit trees.

The following analysis of its food is based upon the examination of the contents of 46 stomachs, taken in various parts of the State and in every month except May. The first division of the food into

animal and vegetable matter gives 78 percent of the former to 22 percent of the latter, exactly the same as in the case of the hairy woodpecker.

Animal food.—Of the animal food, beetles are the largest item, and amount to nearly 34 percent. They consist largely of larval Cerambycidæ, or borers. While not so good a driller for insects as the hairy, the efforts of the Nuttall are not to be despised. It destroys a goodly number of wood-borers, but it eats more adult beetles of other families than do either of the species whose food has been discussed. A considerable number of small leaf beetles (Chrysomelidæ) are eaten by the Nuttall, and are probably taken from leaves. It eats also click beetles (Elateridæ), darkling beetles (Tenebrionidæ), and weevils (Rhyncophora), among which the genus *Balaninus*, that preys upon acorns and other nuts, was identified. A few predaceous ground beetles (Carabidæ) were found.

Ants do not appear to be a favorite food of this woodpecker, and they were eaten very irregularly. They constituted 36 percent of the food in June, 22 percent in September, and appear in small quantities in January and August, but are completely wanting in the other months. The average for the year is less than 6 percent. Other Hymenoptera form practically the same percentage, but nearly all were contained in a single stomach taken in December.

Hemiptera (bugs), like ants, are taken very irregularly and occur either in considerable quantities or not at all. In January they amount to 46 percent of the food of the month, in February to 28 percent, in June to 10 percent, in July to 36 percent, but in the other months do not appear. The average for the year is 11 percent. They belong to several families, but no special pest is prominent. Scales were found in two stomachs and plant lice in one. Three stomachs contained remains of the box-elder bug, *Leptocoris trivittatus*, of which two stomachs contained between 30 and 40 specimens each. This bug is very abundant in some places at times, and injures the box-elder tree. It has also done some damage to fruit.

Diptera (flies) were found only in the stomachs taken in June. They amounted to 12 percent for that month or 1 percent for the whole year.

Caterpillars stand next to beetles in the quantity eaten by the Nuttall woodpecker. They amount to over 13 percent of the food, and, except in the three winter months, appear very regularly. Many of them are of the wood-boring kinds, but leaf-eaters also are present. Various other insects, insects' eggs, and a few spiders amount to 7 percent, and complete the animal food.

Vegetable food.—Fruit amounts to 11 percent, or half of the vegetable food. Naturally most of it was taken during the summer and fall months, although the one stomach taken in December contained

35 percent of fruit pulp not further identified. The greater part of the fruit eaten is of wild species, of which the elder (*Sambucus*) is the favorite. Rubus fruits (raspberry or blackberry) were found in a few stomachs. Probably this bird will never do any serious harm by eating fruit. Seeds of poison oak, cambium, and mast (acorns) make up the other 11 percent of the vegetable food, and have no special economic interest, except that the scattering abroad of the seeds of poison oak is a nuisance. Taken as a whole, the vegetable food of the Nuttall is of little economic importance.

SUMMARY.

While the evidence at hand does not show that this bird feeds on any specific pest, yet it is doing good in preying upon noxious insects in general; moreover, it does not injure any product of husbandry. It should therefore be encouraged to pursue its good work.

RED-BREASTED SAPSUCKER.

(*Sphyrapicus ruber.*)

While the red-breasted sapsucker inhabits most of California at some time of the year, it is generally absent from the valleys during the warmer months, usually retiring to the mountains and forest regions to breed.

Of the 24 stomachs of this species received, nearly all were taken in fruit-growing sections, and represent only the months from September to March inclusive. Statements based upon the examination of so little material can scarcely be considered final, but considerable knowledge may be gained of the kinds of food eaten, even if the relative quantities can not be determined. The food consists of 63 percent of animal matter and 37 percent of vegetable.

Animal food.—Seventy-five percent of the animal food consists of ants, and the average per month is 40 percent of the whole diet. Two stomachs taken in January contained an average of 49 percent each. One stomach collected in March held 84 percent, and one in September was completely filled with them. In other months the amounts were less. In respect to ant eating this sapsucker keeps up the reputation of the family. Other Hymenoptera aggregate only a little more than 7 percent, and all were found in stomachs taken from October to December inclusive.

This bird, like its eastern relative, has the habit of removing patches of bark from certain live trees, usually willows, for the sake of cambium and of the sap which exudes; and it also eats the insects attracted by the sap, which are mostly bees, wasps, and ants; probably this accounts for the large predominance of Hymenoptera in the sapsucker's diet.

Beetles amounted in January to 3.5 percent, in November to 1.4 percent, in December to 0.7 percent, with none at all in the other months. The average for the whole year is only 0.8 percent. No larvæ of wood-borers were found, and apparently this bird never aids the hairy woodpecker in the good work of destroying these creatures. The species eaten were mostly small leaf beetles (Chrysomelidæ), with a few weevils.

Hemiptera (bugs) and Diptera (flies) were entirely wanting in the stomachs examined. Caterpillars were present in two stomachs, both taken in October. They amounted to 5 percent of the food of that month. One stomach taken in February was entirely filled by a large centipede.

Vegetable food.—The vegetable part of the food of the red-breasted sapsucker falls naturally into three divisions—fruit, seeds, and other vegetable matter. As the bird is not present in the fruit-growing sections of the State when fruit is ripe, it can not make great inroads upon the orchard. While fruit aggregates nearly 17 percent, it is mostly wild or of worthless varieties. Figs, whose seeds and pulp were found in one stomach, were the only cultivated kind identified. Several stomachs contained berries of the pepper tree (*Schinus molle*), one contained cascara berries (*Rhamnus californicus*), and in several were unidentified seeds and pulp. Seeds amount to about 9 percent, and are those of the poison oak, with a few others. The miscellaneous item is made up almost entirely of cambium, or the inner bark of trees, and amounts to about 11 percent of the whole food.

SUMMARY.

It is evident that the red-breasted sapsucker falls far below some other members of its family in economic importance. It does not prey upon the worst pests of the orchard and forest, but on the other hand it does not feed on the products of the orchard or farm. It injures trees by tapping holes in the bark and by stripping it off in patches, for which reason this sapsucker may be considered more harmful than beneficial.

CALIFORNIA WOODPECKER.

(*Melanerpes formicivorus bairdi.*)

The California woodpecker is distributed throughout a large part of the State, but is in the main confined to places where there is an abundance of large oaks—trees for which it appears to have a special liking and from which it derives much of its subsistence. Wherever it lives it is usually abundant and the most noticeable element of the bird fauna, attracting attention both by its loud cries and by its conspicuous flight. It is one of the few woodpeckers whose food is more largely vegetable than animal.

Of all the woodpeckers the California has made most impression on nonscientific observers, owing to its peculiar habit of drilling holes into the trunks and branches of dead trees or into the bark of living ones, in each of which it stores an acorn. Wherever the bird is abundant every dead trunk or large branch is punctured with holes, frequently less than an inch apart. So zealous is it in this work that when trees are not available it often drills holes in cornices, church spires, telegraph and telephone poles, and fence posts. The woodpecker does not get the benefit of all its hoarded acorns by any means, for jays, rats, mice, and squirrels have learned where they can obtain food in winter, and are not backward in helping themselves to the woodpecker's stores. As this robbery of his larder is resented by the owner, it leads to endless quarrels.

For the laboratory investigation of the food of the California woodpecker 75 stomachs were available. They were taken in every month except February, April, and May, the greater number in June and July, when the bird's chances to do mischief are greatest. The food consists of 22.43 percent of animal matter to 77.57 percent of vegetable. This is the highest percentage of vegetable matter yet found in the stomach of any woodpecker, though the red-bellied (*Centurus carolinus*) comes very close to it.

Animal food.—Beetles constitute the smallest item of the animal food. They amount to less than 3 percent, and are distributed among several families. The only month in which they are at all prominent is July, when they reach nearly 15 percent. No wood-boring larvæ were found. This would seem to indicate that the bird uses its chisel-shaped bill solely for the purpose of boring holes in which to store acorns, instead of excavating for insects.

Ants amount to 8.21 percent of the food. In one stomach taken in March they constitute 50 percent of the contents, but in no other do they reach 11 percent. The specific name of this bird, *formicivorus*, ant-eating, is not well chosen, for ants do not form a large part of its diet as compared with several other woodpeckers. Other Hymenoptera amount to 6.88 percent. More than half of these were in stomachs taken in August, when they aggregate 33 percent.

A few bugs, flies, and grasshoppers, with fragments of caterpillars, make up the remainder of the animal food, 4.52 percent. One stomach contained a few black olive scales.

Vegetable food.—Grain, fruit, and mast constitute nearly the whole of the vegetable food. One stomach taken in January contained nothing but corn, and another in December contained a few corn hulls. This is the whole of the grain record, and is of no economic interest. The average for the year but slightly exceeds 1 percent. Fruit amounts to a little more than 24 percent, and was found in nearly every month in which stomachs were taken. Most of it was evidently

the pulp of the larger cultivated varieties, though that in the stomachs taken in winter could have had no economic value. Seeds of the elderberry (*Sambucus*) were found in two stomachs. The largest amounts of fruit were eaten in August and September, when they reached 59.34 and 54 percent, respectively. While this is a high percentage of fruit, it is not believed that the bird does any sensible damage in the orchard, since it is not numerous enough and does not usually frequent cultivated ground. No complaints of such damage have yet been heard.

The principal item of food of the California woodpecker is acorns. Acorns form 52.45 percent of the year's food, and were found in every month when stomachs were taken except August; as only three were collected in that month, the record is not very reliable. In November, when 12 stomachs were taken, mast amounted to nearly 93.58 percent of the average contents. In 12 stomachs collected in June, when fruit and insects are abundant, it averaged 79.25 percent. In July it fell to 29.47 percent, the deficiency of acorns being made up by animal food, which attains the highest percentage in that month. The question has been raised whether the woodpecker stores acorns for the sake of the meat, or for the grubs that frequently develop therein. Stomach examination shows that, while the substance of the acorn is eaten freely whenever obtainable, larvæ are almost entirely wanting. It is therefore the nuts themselves that the woodpecker stores for food. From an economic point of view little objection to this acorn-eating habit can be raised. The acorn crop is usually superabundant, and in most cases can not be put to better use than to tide the woodpeckers over the winter until insects become plentiful.

SUMMARY.

From the foregoing discussion of the food of the California woodpecker it is obvious that the bird's food does not possess high economic value. On the other hand the bird can not be charged with the destruction of useful insects or of any product of husbandry. While it eats some fruit, it does not habitually infest orchards, and is seldom numerous enough to be a serious nuisance. The few insects it eats are nearly all harmful.

The trees used by the bird for storehouses are usually dead or partly so, and in living trees the punctures do not go through the bark, so that no harm is done. When holes are drilled in buildings, fences, or telegraph poles, the injury is real, but on the whole the damage done in this way is not extensive.

When the beneficial and injurious habits of the bird are carefully weighed, the balance is decidedly in the bird's favor; and from the esthetic standpoint few birds are more interesting and beautiful.

RED-SHAFTED FLICKER.

(*Colaptes cafer collaris.*)

In food habits the flickers of California do not differ essentially from their eastern relatives. They are usually abundant wherever there are trees, and are frequenters of orchards, though they usually choose higher trees for nesting sites. They are among the most terrestrial of the woodpeckers, and obtain a large part of their food on the ground.

For the investigation of the flicker's food 118 stomachs, taken in all months except January and May, were available. In these stomachs animal food amounts to 54 percent and vegetable to 46 percent.

Animal food.—Beetles, in either adult or larval form, do not appear to be favorite food with the flicker. They amount to 3 percent of its diet, and are apparently eaten to a small extent in every month. In August they amount to 8 percent, in November to 7, and in all other months the percentage is small. They belong to 6 families, all harmful except the predaceous ground beetles (Carabidæ). These occurred in 33 stomachs, but the percentage in each case was small, and they seem to be taken only incidentally. Weevils were found in 4 stomachs, click beetles in one, darkling beetles in 6, rove beetles in 3, and *Notoxus alamedæ* in one.

Ants constitute the largest item of the flicker's food, and are eaten in every month. They are the object of the bird's search on the ground and in rotten logs and stumps. The average for the year is 45 percent, the same as was found in 230 stomachs of the eastern flicker. The stomach and crop of one individual of the eastern form taken in Texas was filled with over 5,000 small black ants (*Cremastogaster*). Each of several California stomachs held more than 1,000 of these insects, and others but few less. In 10 stomachs taken in June the average percentage of ants was 76; in 10 taken in July, it was 87 percent. November was the month of least consumption, when the average of 34 stomachs was 7 percent. Of the 118 stomachs, 78, or 66 percent of the whole, contained ants, and 14 held nothing else, except a little rubbish in three, and in one a few seeds of filaree (*Erodium*). Inasmuch as certain ants in California, in the latter part of summer, make a business of harvesting seeds, probably this particular woodpecker had picked up a few ants that were thus employed. Hymenoptera other than ants are eaten by the flicker only occasionally, and average less than 1 percent of the yearly food.

Miscellaneous insects amount to nearly 5 percent. They consist of common crickets, wood crickets, mole crickets, caterpillars, white ants (*Termes*), spiders, and sow bugs (*Oniscus*). All of these suggest

decaying logs and stumps, where the flicker obtains a large share of its food.

The following insects and crustaceans were identified in the food of the flicker:

COLEOPTERA.

Amara insignis.
Anisodactylus dilatatus.
Anisodactylus piceus.
Calathus ruficollis.
Platynus maculicollis.
Harpalus sp.

HYMENOPTERA.

Formica neorufibarbis.
Cremastogaster lineata.
Lasius sp.
Messor andrei.
Solenopsis geminata.
Prenolepis imparis.

CRUSTACEA.

Porcellio scabra.
Oniscus sp.

Vegetable food.—The vegetable food of the flicker includes many items. They may, however, be grouped under four heads: Mast, grain, fruit, and other vegetable food. Mast forms 10 percent of the food. It is taken fairly regularly, but in the greatest quantity in winter. It was contained in 15 stomachs, 1 holding nothing else. In one case it was English walnut, but in all others it appeared to be the meat of acorns. December showed the maximum amount, 40 percent. Grain was found only in stomachs taken in August, October, and November, the highest percentage being in August, about 17 percent. The total for the year was only 4 percent. It was all contained in 16 stomachs, and consisted of corn in 14 cases, barley in 1, and oats in 1. A stomach taken in November was entirely filled with corn. It is not likely, however, that the flicker ever does serious damage to corn or any other grain. The examinations do not indicate any great fondness for this food, and observation has never shown that the bird makes a practice of visiting grain fields.

Fruit was found in 39 stomachs, in 26 of which it was thought to be of cultivated varieties, but in the other 13 it was wild. Apples, cherries, grapes, prunes, and probably pears were the domestic fruits identified. One stomach was entirely filled with apple pulp and another practically so. Grapes are apparently the favorites. The wild varieties of fruit identified were pepper berries, elderberries, and gooseberries. Fruit pulp that could not be further determined was found in several stomachs and was classified as domestic, although it may have been wild. The aggregate of fruit for the year is 15 percent. While no complaints have been lodged against the flicker for depredations upon fruit, evidently it can do serious damage where it is abundant. It enjoys living in orchards or their immediate vicinity, and, as the stomachs show, does not hesitate to sample their products, but it eats most of its fruit in the latter part of the season, after

cherries, apricots, peaches, and prunes have been gathered. September is the month of greatest consumption, 48 percent. Fruit is taken quite regularly during the rest of the year; but only 6 percent was eaten in June, the month of cherries, and 7 percent in July, the month when apricots are at their best, and none in August, the month of peaches and prunes. The damage done to fruit by the flicker probably consists in spoiling a few choice specimens, rather than in extensive destruction of the crop.

Various other substances make up the remaining vegetable food of the flicker, 17 per cent. Of these the most conspicuous is the seed of poison oak (*Rhus diversiloba*). These noxious seeds were found in 41 stomachs, and 1 was entirely filled with them. Very few are eaten in June and July, but they form an important article of diet through the fall and winter. The month of greatest consumption is October, when they constitute 40 per cent of the total food. The consumption of these seeds would be a decided benefit to man if they were ground up and destroyed in the stomachs. Unfortunately they are either regurgitated or pass through the intestinal tract uninjured and ready to germinate. The action of the stomach simply removes the outer covering, a white, wax-like substance, which is probably very nutritious, and is evidently relished by many birds. Birds are probably the most active agents in the dissemination of these noxious shrubs. On the other hand, these seeds, which are wonderfully abundant, afford food for thousands of birds during the winter, when other food is hard to obtain, and thus enable the birds to tide over the cold season to do their good work of destroying insects the next summer. Seeds of a nonpoisonous Rhus, some weed seeds, and a little rubbish were found in a few stomachs.

The flicker of California, and probably of the west coast in general, has one habit not observed in the eastern species. The mild climate and abundant food supply render migration unnecessary, but, like many other birds that nest in holes in trees, it likes shelter during the winter nights. As trees in which cavities can be made are not numerous enough, it pecks holes in buildings, as barns, schoolhouses, and churches. It often happens that the hole leads into the interior of the building and so proves useless to the bird, and it makes another and another till it hits the right place—in the cornice, for instance. Usually several holes are made before suitable shelter is found, and the consequent disfigurement and damage are sometimes serious.

SUMMARY.

In summing up the food of this flicker, two points are important—the destruction of ants and the eating and consequent scattering of the seeds of poison oak. The destruction of ants is a benefit, but it does not appeal to the horticulturist and farmer as does the destruction of well-known pests. While people are often annoyed by ants,

they seldom suffer much damage by them. However, though ants do not destroy fruit or other crops to any great extent, they aid and abet other insects which do considerable harm. This is particularly true in regard to plant lice, which are housed, protected, and generally cared for by ants. Ants also continue the destructive work in timber begun by beetle larvæ until the wood is rendered worthless. The other insects eaten by the flicker are all more or less harmful, except a few useful ground beetles (Carabidæ). Most of the vegetable food is neutral; the amount of fruit and grain destroyed is not sufficient to constitute serious injury, but the scattering broadcast of the seeds of poison oak is harmful. As on the whole the flicker does more good than harm, it should be protected and encouraged.

OTHER WOODPECKERS.

Several other species of woodpeckers inhabit the State of California but, excepting the Lewis woodpecker, they are neither so numerous nor so generally distributed as those already treated. Their food consists in the main of the same elements, although the proportions vary with the species. The Lewis woodpecker (*Asyndesmus lewisi*) is perhaps the most important of these species, but since only 23 of its stomachs are available for examination, a definite statement of its food during the year can not yet be made. It appears to eat rather more vegetable than animal food, and in fall and winter eats large quantities of acorns. In the selection of its animal food it resembles the flicker in showing a decided taste for ants and other Hymenoptera.

Dr. C. Hart Merriam contributes the following note on this species:

The Lewis woodpecker is one of the commonest and most widely distributed woodpeckers of California, in these respects coming next after the California woodpecker (*Melanerpes formicivorus bairdi*). But owing to its habit of breeding at higher altitudes it is less often seen in the lower and more highly cultivated parts of the State, except during migration. It breeds mainly in the Ponderosa pine forests of the mountains (Transition zone), whence, usually in early September, it descends into the blue oak and Digger pine belt of the foothills to spend the winter.

Like the California woodpecker, it is a skillful flycatcher, pursuing and capturing insects in mid-air. But in fall and winter its principal food is acorns, of which it eats surprising quantities. At this season is is usually seen in small flocks of from 6 to 20 birds, each carrying a large acorn in its bill.

These woodpeckers are very fond of ripening apples, and in early September descend in flocks upon the orchards, particularly those of the higher foothills, and in certain cases, if let alone, destroy practically all the fruit. I have heard of their depredations in various parts of the State and have personally seen the birds, in early September, circling about the orchards and diving down into the apple trees between Round Mountain and Montgomery Creek, and in Fall River Valley, Shasta County, and in Scott Valley and the upper canyon of Klamath River near Beswick, in Siskiyou County. At the latter place they are so destructive that during the ripening of the fruit gunners employed to shoot them frequently kill 25 in a day, and in early September, 1907, I was told that as many as 50 had been killed in one day.

While, as stated above, our investigations have not proceeded far enough to enable a final statement to be made regarding this woodpecker's economic status, enough is known to justify the belief that the bird, by its destruction of insects the year round, is much more beneficial than injurious, despite its occasional depredations on apples and other fruit.

The sapsuckers of the genus *Sphyrapicus* have been accused of doing much harm by boring into fruit and other trees for sap, and while the charge is well founded the injury is largely counterbalanced by the bird's destruction of insects. The sapsuckers are not numerous enough, however, to be reckoned an important factor either way.

FLYCATCHER FAMILY.

(Tyrannidæ.)

Among our useful birds the flycatchers (Tyrannidæ) take high rank. As is well known their principal food consists of insects captured in mid-air. If the name flycatcher implied that these birds subsisted largely upon flies (Diptera), it would be a misnomer, for nearly all the species eat far more Hymenoptera than Diptera. In fact wasp-catcher would be much more appropriate. The name, however, is intended to suggest the idea that the birds are flying when they catch their prey. The capture of food in this way implies that the species are strong, rapid flyers, and capable of making quick turns in the air. In addition to flying insects, the flycatchers eat spiders and other wingless forms and some vegetable food which they pick up from the ground or snatch from trees. The animal food of the 6 species discussed in the following pages averages 90 percent of their diet.

Several flycatchers in the eastern part of the country are quite domestic in their habits and frequent orchards and gardens, and some species nest about buildings. In California some of the corresponding species have not yet become so accustomed to the presence of man and his works, but they are learning rapidly. The black phoebe is perhaps as familiar there as is the common phoebe in the East; but the kingbird of California has not fully decided that the orchard is a safe and altogether desirable place for nesting purposes. Sixteen species and subspecies of flycatchers have been found within the limits of this State. Six of them are numerous enough to be of economic importance.

ASH-THROATED FLYCATCHER.

(*Myiarchus cinerascens.*)

The ash-throated flycatcher is a summer resident of the lower and warmer parts of the State. Its habit of nesting in cavities perhaps causes it to seek the vicinity of farm buildings, where such accommodations are numerous. It builds in hollow trees also, which may often

be found in the older orchards. The eastern species (*M. crinitus*), which nests in hollow trees, habitually places the shed skin of a snake in the walls of its nest. The reason for this is not plain, but the writer has never seen or heard of a nest in which the snake skin was lacking. The ash-throat occasionally does the same thing, but apparently does not consider the snake skin indispensable. Though an orchard bird, it seldom eats any cultivated fruit, but confines its diet largely to insects, most of which are either injurious or neutral.

In the following investigation of the ash-throat, 80 stomachs were used, collected from April to December inclusive, but only one in each month after July. Animal food amounts to 92 percent and vegetable to 8 percent for the season. Stomachs taken in April, May, August, October, and November contained no vegetable food whatever. The one stomach taken in September held 44 percent of elderberries, which is exceptional. A greater number of stomachs in this month would probably have reduced this percentage considerably.

Animal food.—Of the animal food, beetles, almost entirely of harmful species, amount to 5 percent. The two families most prominent in the food are the longicorns (Cerambycidæ) and the metallic woodborers (Buprestidæ), which are the very ones whose larvæ are so extensively eaten by woodpeckers. Next to these were the click beetles (Elateridæ), that bore into various plants and do much damage, and a few weevils or snout beetles (Rhynchophora). A ground beetle (Carabidæ) was found in one stomach, and a ladybird (Coccinellidæ) in another, these being the only useful beetles taken.

Bees, wasps, and a few ants (Hymenoptera) amount to 27 percent. They are eaten regularly in every month when the bird is on its summer range. Five stomachs were taken in the vicinity of an apiary, but not one of them contained a trace of a honey bee, though one bird had eaten 24 percent of robber flies (Asilidæ), which have been known to prey upon bees.

Bugs (Hemiptera) aggregate about 20 percent of the food of the ash-throat, which is the largest showing for that order of insects yet found in the food of any flycatcher. They were all eaten in the months from May to August inclusive, and form a good percentage in each of those months. They belong to the families of stinkbugs (Pentatomidæ), shield bugs (Scutelleridæ), leafhoppers (Jassidæ), jumping plant lice (Psyllidæ), common plant lice (Aphididæ), tree hoppers (Membracidæ), cicadas (Cicadidæ), and assassin bugs (Reduviidæ). The last is a family of predaceous insects which are useful, as they destroy some harmful insects, but all the others are injurious, and some are pests. While many of these are taken upon the wing, probably some are picked from plants. One bird was seen on a mustard plant feeding upon the plant lice, which completely infested the

plant. One stomach was entirely filled with tree hoppers and two with cicadas.

Flies (Diptera) amount to about 14 percent and were eaten in nearly every month. Robber flies were identified in two stomachs, one of which has already been referred to. Most of the others were of the family of the common house fly (Muscidæ).

Caterpillars were found in 20 stomachs and moths in 7. Together they amount to 19 percent of the food. This shows that caterpillars are a favorite article of food with this bird, and proves that it does not take all its food on the wing. While no stomach was entirely filled with caterpillars, one contained nothing but moths.

Grasshoppers formed about 5 percent of the food, and were mostly taken in May, June, and July. One stomach contained nothing else. As they do not often come within reach of flycatchers, these insects must be especially sought for.

Various other insects and spiders amount to a little more than 3 percent. Among these the two most prominent were dragonflies and Raphidia. These last are small insects with remarkably long necks, and as they prey upon other insects and are said to feed upon the larvæ of the codling moth, their destruction by birds is to be deplored. Spiders are eaten by the ash-throat quite regularly, but not extensively. Apparently, most birds take spiders when found, but do not seek for them.

Vegetable food.—Vegetable food was found in 9 stomachs. Of these, 5 contained remains of elderberries; 2, bits of other small fruit; and 2, skins which might have been those of cultivated varieties. The total for the year is 8 percent.

Feeding of young.—Besides the examination of stomachs of the ash-throated flycatcher, observations were made upon the feeding of a nest of young situated in the cornice of an abandoned ranch house. The nest contained four young about a week old when first discovered. The number of feedings and times of observations are given in the following table:

Date.	Hours in forenoon.	Number of feedings.	Hours in afternoon.	Number of feedings.
June 18			12.59–1.59	9
June 22	10.48–11.48	14	2.07–3.07	9
June 26			2.13–3.13	18
Do			5.56–6.26 (half-hour.)	6
June 27	5.15– 6.15	28		
Do	11.27–12.27	9	4.47–5.47	9
June 28	5.26– 6.26	16		

In all, the nest was observed for eight and one-half hours and 119 feedings were noted, or an average of 14 feedings per hour. Both parent birds took part in the feeding until the female was unfortunately killed after the first hour of feeding on the morning of June 27. It will be noted that during this early hour more feedings were observed than at any other, and that at practically the same hour the next morning, June 28, the male bird alone was able to feed only 16 times. However, the young did well, and left the nest that afternoon. As the day was about fourteen hours long when the above notes were taken, each of the young birds must have been fed about 49 times every day, or 196 insects in all. It is safe to say that the parents would eat enough more to bring the total up to 250. Several nests of this bird in an orchard would make quite a difference in the number of insects surviving to propagate the next year's supply.

SUMMARY.

From the foregoing it is evident that the ash-throat attacks no product of husbandry, but keeps up an incessant war upon insects. Of these it devours a vast number in the course of the year, mostly harmful species. This bird likes to reside in the vicinity of houses, gardens, and orchards. Let it be encouraged by all means.

ARKANSAS KINGBIRD.

(*Tyrannus verticalis.*)

The Arkansas kingbird (Pl. II) inhabits the lower and warmer part of the State, mainly as a summer resident. It is not so domestic as its eastern relative, the common kingbird, and seems to prefer the hill country, with scattering oaks, rather than the orchard or the vicinity of towns or ranch buildings.

For the investigation of the kingbird's food 78 stomachs were available. Most of them were taken from March to July inclusive, but a few in September, October, and December. The bird's yearly food is made up of 87 percent of animal matter to 13 percent of vegetable.

Animal food.—The animal food is composed of insects and a few bones of a batrachian (tree frog or salamander). Both the eastern and western kingbirds have been accused of destroying honey bees (*Apis mellifera*) to a harmful extent. It is said that the birds linger about the hives and snap up the bees as they return home laden with honey. Remains of honey bees were searched for with special care, and were found to constitute 5 percent of the food. Thirty-one individuals were discovered in 5 stomachs. Of these, 29 were drones, or males, and 2 were workers. In 3 stomachs containing males there was no other food, and when it is borne in mind that there are thou-

sands of worker bees to one drone, it appears that the latter must be carefully selected. As a rule, the destruction of drones is not an injury to the colony, and often is a positive benefit. The food of the eastern kingbird shows practically the same ratio between drones and workers. Hymenoptera other than honey bees amount to 38 percent, and include wild bees, wasps, and ants, with a few parasitic species. The latter are very useful insects, and their destruction is an injury, but fortunately the kingbird is not especially fond of them.

The late Walter Bryant, of Santa Rosa, Calif., says:

> Mr. A. Barnett, of San Diego County, had 300 swarms of bees, which attracted the flycatchers to such an extent that he made some investigations to ascertain to what extent they might be damaging the bee industry.
>
> Over 100 flycatchers were dissected, principally Arkansas flycatchers and phoebes (Black and Say's?). In all of the Arkansas flycatchers drones were found, but no working bees, although in many cases the birds were gorged. In most of the phoebes drone bees were found; the only exception was that of a phoebe (Say's?) in which a bee's sting was found in the base of the tongue.
>
> The birds were all shot about apiaries and were seen darting upon and catching the bees.[a]

Such testimony is sufficient to clear these flycatchers of the suspicion that they interfere with the bee industry.

Beetles of various families form about 14 percent of the food. They are all harmful species except a few predaceous ground beetles and ladybird beetles. They were taken very regularly through the months, and appear to be a favorite food.

Orthoptera—grasshoppers and crickets—amount to 20 percent. They were taken pretty regularly through all the months. Even the 3 stomachs secured in December show an average of 44 percent. Probably few of these were caught on the wing, and their abundance in the food indicates that this bird, like many others, forsakes its usual style of feeding and goes to the ground to catch grasshoppers whenever they are numerous. Two stomachs were entirely filled with these insects, and in several others they amounted to over 90 percent of the contents.

Miscellaneous insects, consisting of caterpillars and moths, a few bugs, flies, and a dragonfly, constituted 10 percent. Several stomachs contained a number of moths, and one was entirely filled with them. Not many birds eat these insects extensively in the adult form, while the larvæ (caterpillars) are a prominent feature of the diet of most insectivorous birds. Besides insects, bones of some batrachian, probably a tree frog, were found in three stomachs and an eggshell in one. They amount to only a trifling percentage. Frogs or salamanders seem queer food for a flycatcher, but their bones have been

[a] Zoe, IV, pp. 57–58, 1893.

found in the stomachs of several species of tree-haunting insectivorous birds.

The following is a list of insects identified in the stomach of the Arkansas kingbird:

COLEOPTERA.

Platynus sp.
Aphodius fimetarius.
Amphicoma ursina.
Cremastochilus sp.
Geotrupes sp.
Megapenthes turbulentus.
Epicauta sp.
Hydaticus stagnalis.
Agabus sp.
Silpha ramosa.
Staphylinus luteipes.
Balaninus sp.

HYMENOPTERA.

Apis mellifera.
Prosopis affinis
Habropoda sp.
Melissodes sp.
Andrena sp.
Cryptus sp.
Ophion bilineata.

HEMIPTERA.

Euschistus servus.
Nezara sp.
Podisus modestus.
Calocoris rapidus.
Eurygaster alternatus.

Vegetable food.—The vegetable food of the Arkansas kingbird amounts to about 13 percent, and consists mostly of fruit. It was all contained in 15 stomachs, of which 10 held elderberries (*Sambucus*) and 5 various small berries not positively identified. One also contained an olive, the only cultivated fruit found. A few seeds also were noted.

SUMMARY.

In a summary of the economic significance of the food of this kingbird it should be noted that the bird must be judged by its destruction of insects, for, since it does not eat any product of cultivation to an appreciable extent, its vegetable food can be disregarded. The offense of eating honey bees, so long laid at this bird's door, is practically disproved, for the more or less useless drones eaten far outnumber the useful workers. The injury the kingbird does, if any, is by eating predaceous beetles and parasitic Hymenoptera, but it takes these in such small numbers as to leave no reasonable doubt that the bird is one of our most useful species.

CASSIN KINGBIRD.

One other species of *Tyrannus* (*T. vociferans*), commonly known as the Cassin kingbird, occurs in the southern half of the State, where it frequents orchards and ranches. It is less abundant than the Arkansas kingbird, but has similar habits, and an examination of several stomachs shows that the food of the two species is practically the same.

SAY PHOEBE.

(Sayornis saya.)

While the Say phoebe inhabits California throughout the year, it is locally wanting in summer in many places west of the Sierra. In the fruit-growing regions visited, the writer met with only one individual during the spring and summer months, but these phoebes became fairly numerous in September, and increased in numbers as the season advanced. The investigation of their food was based upon the examination of 86 stomachs, taken in every month from September to March inclusive, and 2 taken in June. This bird was shown to be one of the most exclusively insectivorous of the family, although no stomachs were available for the months when insects were most numerous. The food consists of 98 percent of animal matter and 2 percent of vegetable.

Animal food.—As a number of predaceous ground beetles (Carabidæ) were in these stomachs, a separate account was kept of them. They amount to somewhat over 5 percent, and are pretty evenly distributed through the months, except February, in which 25 percent were eaten. These were in one stomach, which they half filled, and as only 2 stomachs were taken in that month, the percentage was probably made too great. It seems impossible that all these beetles, which are rather averse to flying, could have been caught on the wing, especially since none were taken in the warmer months, when they are most active. In the other beetle food, which amounts to 10 percent, a few ladybirds (Coccinellidæ) were found. These and the ground beetles must be recorded against the bird, but the fault is not serious. The remainder of the beetles were all of injurious or neutral species.

Hymenoptera, including quite a number of ants, amount to 35 percent, and were contained in 69 stomachs, or over 78 percent of the whole. This illustrates the statement that these birds are wasp-catchers rather than flycatchers. A few parasitic species were among the rest. Bugs, as is so often the case, were eaten quite regularly, but in rather small quantities. They amount to about 5 percent of the food, and belong to the following families: Stinkbugs (Pentatomidæ), the squash-bug family (Coreidæ), leaf bugs (Capsidæ), negro bugs (Corimelænidæ), leafhoppers (Jassidæ), tree hoppers (Membracidæ), and assassin bugs (Reduviidæ). These last are reckoned as useful insects, but they were identified in only one stomach.

Flies (Diptera) aggregate 10 percent of the food, and were eaten mostly in the months of January, March, and November; but probably this is accidental and would not hold true with a greater number of stomachs. The only family identified was that of the common

house fly (Muscidæ). One stomach was entirely filled with them. Moths and caterpillars (Lepidoptera) appeared in 27 stomachs, and amount to something more than 10 percent of the food. Moths were found in 15 stomachs and caterpillars in 12. This is contrary to the usual rule that in this order of insects the larvæ are eaten by birds much more freely than are the adults.

Grasshoppers and crickets (Orthoptera) are eaten by the Say phoebe to the extent of 14 percent, which is the highest record of any flycatcher except the Arkansas kingbird. These, taken in connection with the ground beetles, ants, and caterpillars, indicate a somewhat terrestrial habit of feeding. Nearly 40 percent of the grasshoppers consumed were taken in September, after which they steadily decreased in quantity. One stomach was entirely filled with them.

Miscellaneous insects, spiders, and a few other creatures make up the rest of the animal food, about 8 percent. Of these, spiders were found in 10 stomachs, dragonflies in 5, sowbugs (*Oniscus*) in 1, and another unidentified crustacean in 1.

Vegetable food.—The vegetable food of the Say phoebe amounts to 2 percent, and is made up of a little fruit, a few seeds, and some rubbish. One seed and a stem of a fig were the only indications of cultivated fruit. Remains of elderberries were noted in 3 stomachs, seeds in 4, pulp of a large seed or nut in 1, and rubbish in 4.

SUMMARY.

The economic relations of the Say phoebe depend wholly upon its animal food, for it eats practically no vegetable matter of any interest to man. That it takes a few useful insects can not be denied, but the stomachs' contents show that they are far outnumbered by harmful species, and the balance is clearly in favor of the bird.

BLACK PHOEBE.

(*Sayornis nigricans.*)

The black phoebe inhabits the lower valleys of California, and in most parts can be found throughout the year. For a nest site it selects the wall of a canyon, a shed, the overhanging eaves of a barn, or, better still, a bridge. It has a pronounced preference for the vicinity of water. Even a watering trough by the roadside usually has its attendant phoebe.

While camping beside a stream in California, the writer observed the feeding habits of the black phoebe. The nesting season was over, and apparently the birds had nothing to do but capture food. This they appeared to be doing all the time. In the morning, at the first glimmer of daylight, a phoebe could always be seen flitting

from rock to rock, and probably it caught an insect on each flight. This activity was kept up all day. Even after supper, when it was so dark that notes had to be written by the aid of the camp fire, the phoebes were still hunting insects.

Observations like these convince any reasoning person that the number of insects destroyed in a year by this species is something enormous, and the examination of stomachs confirms field observations. This bird eats a higher percentage of insects than any flycatcher yet studied except the western wood pewee. For the study of this phoebe's food 333 stomachs were available, collected in every month in the year and from various parts of the State. They show 99.39 percent of animal matter to 0.61 percent of vegetable.

Animal food.—In examining the food contained in the stomachs of the black phoebes, account was kept of the beetles that are generally supposed to be useful, namely, the ground beetles (Carabidæ), the ladybirds (Coccinellidæ), and the tiger beetles (Cicindelidæ). It was found that these beetles were eaten pretty regularly throughout the year; in fact, there is no month which does not show a certain percentage of them. The average for the year, however, is only 2.82, or practically 3 percent, not a heavy tax on the useful beetles. Other beetles, all more or less harmful, amount to 10 percent. They were eaten in every month, and though the quantity varies to some extent, the variation appears to be accidental.

Hymenoptera amount to over 35 percent of the yearly food. They were found in 252 out of the 333 stomachs, and in 11 there was no other food. They are eaten throughout the year. March is the month of least consumption, with only 1 percent, while August shows the maximum, nearly 60 percent. A few ants and several parasitic species are eaten, but the great bulk of this item is made up of wild bees and wasps. Not a trace of a honey bee was found in any stomach.

Hemiptera of several families were eaten to the extent of about 7 percent. They were pretty uniformly distributed through the food of the year, except that none were taken in May, which, however, is probably accidental. Four of these families are aquatic, which partly explains why the bird is so fond of the vicinity of water. The Reduviidæ are insectivorous, and therefore useful. They were found in but one stomach. The other families are vegetable feeders; all of them likely to be harmful, and most of them pests. The plant lice found in the food are rather unexpected, but, as already noted, flycatchers do not take all their food on the wing.

Flies (Diptera) were eaten by the black phoebe to the extent of over 28 percent. They appear in every month, and range from 3 percent in August to 64 percent in April. They were found in 127 stomachs, 10 of which contained nothing else. The house-fly family (Muscidæ), the crane flies (Tipulidæ), robber flies (Asilidæ), and one

horsefly (Tabanidæ) were the only ones identified. Grasshoppers and crickets are not extensively eaten by the phoebe. They amount to about 2½ percent for the year, being eaten rather irregularly; five months show none at all. The greatest consumption was in April, nearly 8 percent.

Moths and caterpillars are eaten to the extent of 8 percent. They were found in 72 stomachs—moths in 38, caterpillars in 32, and both in 2. A few unidentified insects and several miscellaneous ones, principally dragonflies, with some spiders, make up the rest of the animal food, 6 percent. Dragonflies are taken quite frequently, but generally in no great numbers. One stomach was entirely filled with them, and several were nearly so. The fact is, these insects are so large that often a single one fills a phoebe's stomach. These insects are too strong and agile upon the wing to be captured by anything less expert than a flycatcher, and in the few instances where they appear in other birds' stomachs they were probably found dead. The spiders eaten by the phoebe are perhaps snapped from the tops of weeds as the bird flies over, or taken from the web. While quite frequently eaten, they form only a small percentage of the diet.

The following is a list of insects identified in the stomachs of the black phoebe:

COLEOPTERA.

Elaphrus riparius.
Triæna longula.
Bradycellus rupestris.
Laccobius ellipticus.
Philonthus pubes.
Hippodamia convergens.
Coccinella transversoguttata.
Coccinella californica.
Chilocorus orbus.
Cryptorhopalum apicale.
Hister bimaculatus.
Saprinus obscurus.
Saprinus lugens.
Saprinus lubricus.
Carpophilus hemipterus.
Heterocerus tristis.
Canthon sp.
Aphodius granarius.
Aphodius vittatus.
Aphodius ungulatus.
Amphicoma ursina.
Gastroidea sp.
Lina scripta.
Diabrotica soror.
Blapstinus pulverulentus.
Corphyra sp.
Notoxus alamedæ.

HEMIPTERA.

Hygrotrechus sp.
Largus succinctus.

In addition to the above species the following families of Hemiptera were identified:

Giant water bugs (Belostomatidæ).
Creeping water bugs (Naucoridæ).
Broad-shouldered water striders (Veliidæ).
Water striders (Hydrobatidæ).
Assassin bugs (Reduviidæ).
Leaf bugs (Capsidæ).
Red bugs (Pyrrhocoridæ).
Chinch-bug family (Lygæidæ).
Stink bugs (Pentatomidæ).
Leafhoppers (Jassidæ).
Tree hoppers (Membracidæ).
Jumping plant lice (Psyllidæ).
Plant lice (Aphididæ).

Vegetable food.—The vegetable food of the black phoebe amounts altogether to only 0.61 percent, and may be classified under two heads: Fruit and other vegetable matter. Fruit forms 0.34 percent, and the only species identified were elderberries in 19 stomachs, dogwood (*Cornus*) in one, and *Rubus* (blackberries or raspberries) in one. This last may have been cultivated; and some fruit skins found in 1 stomach may also have been of a domestic variety. Miscellaneous vegetable food consists of poison oak seeds in 2 stomachs, a catkin in 1, and rubbish in 1.

Food of young.—Among the 333 stomachs of the black phoebe were those of 24 nestlings, varying in age from 1 to 2 weeks. Their food was tabulated by itself to ascertain if it differed from that of the adults. No great difference was apparent in the kind of food eaten nor in the relative proportions. One point, however, was noted. The percentage of animal food was a little lower than in the adults; not because the young had intentionally eaten any vegetable food, but because, along with other food, the parents had fed a quantity of rubbish, dead grass, leaves, and the like. The same apparent carelessness as to the food of their young has been observed in other species.

SUMMARY.

In a summary of the food of the black phoebe the vegetable part may be dismissed as unimportant. Of the insect food we have less than 3 percent of theoretically useful beetles, a few parasitic Hymenoptera, and a few dragonflies, say, 5 percent in all, to offset 94 percent of harmful species. This phoebe is an efficient insect destroyer, and is an invaluable asset to the people of California or any other State it may inhabit. It should be rigidly protected and in every way encouraged.

WESTERN WOOD PEWEE.

(*Myiochanes richardsoni.*)

The western wood pewee is a familiar sight in the fruit-growing sections of the State, where its time is spent in a tireless search for insects. Wherever in the orchard there is a dead limb, there on the outermost twig perches the pewee, and from its lookout sallies forth to snatch up any luckless insect that comes within range. Several such perches are usually to be found not far apart, and the bird occupies them in turn as the game becomes scarce in one or the other place. The little western flycatcher (*Empidonax difficilis*) has the same habits, and shares these watchtowers with the pewee. Observation of one of these perches for three minutes, watch in hand, furnished a good idea of the bird's industry. In the first minute it took 7 insects, in the second 5, and in the third 6, or 18 in the three minutes.

Apparently it had been doing the same thing for an hour, perhaps all the morning. These observations were made at 10 a. m., when the air was warm and insects were on the wing. Either the same bird or another was watched the next day at 9 a. m. near the same spot, and 17 captures were noted in eight minutes. This morning was cooler, and fewer insects were abroad than on the previous day. The mean of these two observations is 4 insects per minute. If the bird keeps this up for even ten hours a day, the total is 2,400 insects. It hardly seems possible that one bird could eat so many unless they were very small, but this pewee is rarely seen when it is not actively hunting. When the young are in the nest, the parents must make great havoc with insects if the nestlings are fed at the above rate.

The pewee remains in California only about six months in the year, but fortunately this is the season when insects are most numerous. One hundred and thirty-seven stomachs, taken in the months from April to September inclusive, were available for examination. Animal matter formed 99.91 percent of the contents and vegetable matter 0.09 percent, or less than one-tenth of 1 percent. The percentage of animal matter is the highest yet found in the food of any flycatcher.

Animal food.—Beetles amount to about 5 percent of the food. With the exception of Carabidæ, found in 4 stomachs, and Coccinellidæ, in 5, all were either harmful or neutral species.

The following beetles were identified:

Coccinella 9-notata nevadica.
Coccinella californica.
Coccinella transversoguttata.
Hippodamia ambigua.
Hippodamia convergens.
Hister bimaculatus.
Saprinus plenus.
Carpophilus hemipterus.
Aphodius vittatus.
Agrilus sp. nov.
Agriotes sp.
Gastroidea sp.
Blapstinus sp.
Ptilinus basalis.
Baris rubripes.

Hymenoptera aggregate over 39 percent, and are of wild species—that is, there are no domestic bees among them. They were found in 93 stomachs, and in 14 there was nothing else. Parasitic species were identified in 7 stomachs and ants in only 2—an unusually small record for ants, which are favorite food with flycatchers.

Hemiptera, or bugs, are evidently not esteemed as an article of diet by this bird, for they amount to less than 2 percent of the food. None were eaten in April or May, but nearly half the whole number were taken in August.

Diptera amount to nearly 40 percent, slightly exceeding Hymenoptera. No other flycatcher has yet been noted whose food contained more Diptera than Hymenoptera; hence the name flycatcher is peculiarly applicable to this pewee. Diptera were found in 84 stomachs,

and 20 contained no other food. This would seem to indicate that flies are preferred to other insects. The families Muscidæ, Tipulidæ, and Asilidæ were recognized.

Caterpillars and moths amount to nearly 5 percent. Though not taken in great numbers, they are eaten regularly through the season. September shows the greatest consumption—over 14 percent. Moths were found in 18 stomachs and caterpillars in 4. One stomach was entirely filled with the remains of moths.

Sundry insects, amounting to nearly 9 percent, make up the rest of the animal food. Dragonflies were found in 7 stomachs, and 1 contained nothing else. Ephemerids were in 4 stomachs, lace-winged flies in 1, spiders in 3, and the so-called jointed spiders in 1.

The character of the food shows that it is taken on the wing more exclusively than that of any other bird yet examined. Of the creatures that do not fly, ants were found in 2 stomachs, caterpillars in 4, spiders in 3, and jointed spiders in 1. As some ants fly, these may have been taken in mid-air, but they were too badly broken to determine this point.

Vegetable food.—Vegetable matter was found in 4 stomachs, but in 3 of these it was mere rubbish. One contained seeds of the elderberry, the only vegetable food observed.

SUMMARY.

The western wood pewee, while often an inhabitant of the orchard, does not deign to taste of its product, if the above record may be assumed to be conclusive. Its diet is composed almost exclusively of insects, and of these a large majority are harmful species.

WESTERN FLYCATCHER.

(*Empidonax difficilis.*)

The western flycatcher avoids alike the hot valleys and the high mountains of California during the warmer months, but is more generally distributed in migration. For a nesting site it selects a tree, a crevice among the roots of an overturned stump, a bracket under a porch, a beam under a bridge, or a hole under an overhanging sod on the bank of a stream. It has much the same liking for water as the black phoebe, though even more pronounced. A small stream running through or near an orchard appears to supply ideal conditions for this little flycatcher, as the orchard makes an excellent foraging ground, and if it does not afford a nesting site, the bank of the stream will. The bird is quiet and unobtrusive, and often the first notice one has of its presence is to see it dart from the end of a near-by twig into the air in pursuit of an insect. It seems to be thus engaged all day; in fact, the writer has never seen one of these birds when it was not in search of food.

In the laboratory investigation of the food of the western flycatcher 141 stomachs were examined. They were collected from March to October inclusive, and probably give a fair idea of the bird's food for these months. Analysis gives 99.28 percent of animal food to 0.72 percent of vegetable; in other words, there was less than three-fourths of 1 percent of vegetable matter. Only one other flycatcher, the western wood pewee, eats so little vegetable food.

Animal food.—In this analysis a separate account was kept of the ladybird beetles (Coccinellidæ). This bird appears to eat more of them than does any other flycatcher, but the number for the whole season is not large enough to be very serious. The greatest consumption occurred in August, a little more than 7 percent. The average for the season is 2⅓ percent. Other beetles amount to nearly 6 percent, nearly all harmful, the exception being a few ground beetles (Carabidæ).

Hymenoptera form the largest constituent of the food of this as of most other flycatchers. They amount to over 38 percent, and are an important item during every month of the bird's stay on its summer range. The highest percentage is in March, 61; but as only 3 stomachs were taken in that month, the record can not be considered as final. June shows 52 percent, and is probably nearer the true maximum, although August and September do not fall much below. Ants were found in 14 stomachs, and parasitic Hymenoptera in but 2. Hymenoptera in general were found in 99 stomachs, and 6 contained nothing else. No honeybees were identified.

Hemiptera (bugs) amount to nearly 9 percent of the food. They were found in 49 stomachs, 2 of which were entirely filled with them. The greatest number were taken in August, when they constituted 29 percent. The following families were identified:

Stink-bug family (Pentatomidæ).
Chinch-bug family (Lygæidæ).
Leaf-bug family (Capsidæ).
Leafhopper family (Jassidæ).
Tree-hopper family (Membracidæ).

Diptera amount to a little more than 31 percent of the whole food. They rank next to Hymenoptera, and, like those insects, are taken very regularly during every month of the bird's stay in the State. While October is the month of maximum consumption, 47 percent, several other months are but little below. Only 3 families were identified: The crane flies (Tipulidæ), the soldier flies (Stratiomyiidæ), and the house flies (Muscidæ).

Lepidoptera, in the shape of moths and caterpillars, amount to about 7 percent for the year, and were found in every month except March. They appeared in 36 stomachs, of which only 7 contained the adult insects—moths—and 29 the larvæ or caterpillars. This taste is in contrast with that of the black phœbe and the wood pewee,

which prefer moths, but is quite in accordance with the general rule among insectivorous birds. Special interest attaches to this item of the bird's food from the fact that larvæ of the codling moth were found in 3 stomachs. In one 15 were counted, which amounted to 89 percent of the food. In another they were too badly broken to be counted, but formed 55 percent of the contents. In the third only 1 was found, amounting to 3 percent. Evidently these insects were hibernating in a crevice in the bark of a tree or some similar place, and were there discovered by the flycatcher.

A few unidentified insects and some spiders make up the remainder of the animal food—about 6 percent. Spiders were found in 19 cases—in 1 stomach amounting to 70 percent—and these, with the caterpillars, particularly the codling-moth larvæ, show that a considerable percentage of the food of this bird is not caught on the wing.

The following is a list of insects identified from the stomachs of the western flycatcher:

COLEOPTERA.

Aleochara bimaculata.
Hippodamia ambigua.
Hippodamia convergens.
Coccinella californica.
Scymnus sp.
Telephorus divisus.
Aphodius sp.
Limonius infuscatus.
Gastroidea cyanea.
Diabrotica soror.
Monoxia sordida.
Epitrix sp.
Eulabis rufipes.
Blapstinus ruficeps.
Deporaus glastinus.
Balaninus sp.

DIPTERA.

Stratiomyia maculosa.

LEPIDOPTERA.

Carpocapsa pomonella.

Vegetable food.—Vegetable matter was found in 16 stomachs, though some of it could not properly be called food. One stomach contained seeds of Rubus fruit (blackberries or raspberries); 7, seeds of elderberries; 1, the skin of an unidentified fruit and a seed of tarweed (*Madia*); while 6 held rubbish. The Rubus fruit might have been cultivated, but probably was not.

Food of young.—Among the stomachs whose contents have been discussed were those of 15 nestlings, varying in age from 48 hours to 2 weeks, which show no marked differences from those of adults. Only 2 of these stomachs contained any vegetable matter; in 1 was 15 percent of rubbish; in the other 3 percent. Gravelstones were found in several cases, and have been observed in the young of other insectivorous birds, even when not found in adults of the same species.

The young in one nest were fed 24 times in an hour. Owing to the nest's location the number of nestlings was not ascertained. If there were four, as is probable, and the feeding was continued fourteen hours, each was fed 84 times during the day.

SUMMARY.

From the foregoing it is evident that neither the farmer nor the fruit grower has anything to fear from the western flycatcher. Practically it eats no vegetable food, and its animal diet contains less than the normal proportion of useful elements. It should be rigidly protected at all seasons.

OTHER FLYCATCHERS.

Four or more other species of the genus *Empidonax* occur within the limits of California. They are not so domestic as the one just discussed, but their food habits are quite similar. One, *E. traill*i, is locally quite abundant, but chooses the willows along water courses for its home rather than the orchards. The others are less widely distributed and therefore of less economic importance. A few stomachs of each species have been examined, but they indicate no remarkable differences in food habits from those of the western flycatcher.

HORNED LARK.

(*Otocoris alpestris chrysolæma*, *rubida*, and other subspecies.)

Not only in California, but in a considerable portion of temperate North America, some form of the horned lark occurs wherever plain or valley presents the condition suited to its peculiar needs. The former generic name, *Eremophila*, or desert lover, was peculiarly appropriate, but unfortunately it was necessary to displace it. Bare, level ground with scant herbage and no trees or shrubs appears to be the ideal condition for the horned lark. While on the Pacific coast they are not called upon to endure excessive cold, yet elsewhere they endure low temperatures not only with indifference but with apparent pleasure. The writer has met them on an open prairie when the temperature was nearly 30 degrees below zero, and though a fierce gale was blowing from the northwest they did not exhibit the least sign of discomfort, but rose and flew against the wind, then circled around and alighted on the highest and most windswept place they could find. Probably they remain through the night in these bleak spots, for they may frequently be seen there after sunset. Most animals seek shelter from wind and cold, even though it be nothing but the leeward side of a ridge or hummock, but the horned lark refuses to do even this, and by preference alights on the top of the knoll where

the wind cuts the worst. It seems strange that in so small a body the vital heat can be maintained under such adverse conditions, but if one of these birds be examined, its body will be found completely covered with a thick layer of fat, like the blubber on certain marine animals. This indicates that horned larks have plenty to eat, and that their food is largely carbonaceous. The necessity for such heat-producing food does not exist in the case of the California horned larks, but nevertheless they eat the same substances as those in a colder climate, although probably in reduced quantities.

The food of this bird consists largely of seeds picked up from the ground. Very naturally a bird that subsists on scattered seeds would pick up kernels of grain if they came in its way, and some persons have declared that this bird does serious damage to newly sown grain. As they sometimes associate in immense flocks, they may do harm when large numbers alight on a field before the grain has been harrowed in. Drilling the grain, which is the modern method, will obviate this trouble. Most of the grain eaten by these larks is waste from the harvest field.

For the investigation of the food of the horned larks of California, 259 stomachs, collected in every month except May, were available. While very irregularly distributed through the year, they probably give a fair idea of the annual food. In the analysis of the contents of these stomachs, approximately 9 percent of animal food was found to 91 percent of vegetable.

Animal food.—The horned lark is essentially a vegetarian, but eats a considerable number of insects during the reproductive season and feeds many to the young. Most of the animal food was taken between March and June, inclusive. The latter has the highest record, nearly 30 percent. As this lark is an early breeder, it begins eating insects early in the season. After June there is a rapid decrease in animal food, and the stomachs taken in November contained none whatever.

For convenience this part of the diet may be divided into the two items, beetles and other insects. Beetles amount to about 5 percent. Like the animal food in general, they were found in greatest quantities in the stomachs taken from March to June, the latter month showing a little over 20 percent. While a few predaceous ground beetles were eaten, the great bulk of these insects were of harmful species, among which were some snout beetles or weevils. The remainder of the animal food, 4 percent, consisted of bugs, ants, caterpillars, and a few miscellaneous insects and spiders. Of these, the greater number are either harmful or neutral.

Vegetable food.—The great interest in the food of the horned lark centers about the vegetable part. This consists of grain and weed seed. Corn was found in only one stomach. Wheat was contained

in 21 stomachs, taken in four months: January, February, June, and July. The irregularity in eating grain would seem to indicate that it is not a favorite food. The midsummer records may be explained on the ground that these are the harvest months in California. But it is not supposable that wheat could be obtained in January and February and not in December or March. The greatest amount was eaten in February, 74 percent, but only 5 stomachs were taken in this month, and probably a greater number would have given a lower percentage. The average for the year is 9 percent. Of all the grains, however, oats are the favorite with the horned larks, as they are with so many other seed-eating birds. They were eaten much more regularly than wheat and in greater quantities. They were found in 142 stomachs, and November gives the highest record, 77 percent, while June has the lowest, a little over 8 percent. The average for the year is 31 percent. If all these oats were taken from the farmer's crop it might be a serious tax, but evidently only a few of them are so obtained. Those eaten in March may have been from newly sown fields, and those in June and July from the ripening crop, but the rest must have been waste grain gleaned from the fields, Moreover, California is covered with wild and volunteer oats, which, ripening at other times than the cultivated ones, furnish an inexhaustible supply of food for many birds. It is certain that most of the oats eaten by the California horned larks are either waste or volunteer grain, and have no economic value.

The particular food of horned larks is the seeds of weeds and grasses. These aggregate 51 percent of the annual diet, being eaten in every month, and constitute a respectable percentage of the food in each. The month of least consumption is January, when they amount to over 19 percent; August shows the maximum quantity, nearly 99 percent, but as only 4 stomachs were taken in this month, probably ample material would reduce this high percentage. It is by the consumption of weed seed that the horned lark makes amends for doing a little damage to grain. The quantity of seeds of noxious weeds destroyed annually by this species throughout the country is very great. Fruit does not appear in the stomachs of horned larks. The bird asks nothing of the orchardist—not even the shelter of his trees.

SUMMARY.

In the final analysis of the food habits of the horned lark there is but one tenable ground of complaint, namely, that it does some damage to newly sown grain. This can be largely remedied by harrowing in immediately after sowing, and can be wholly prevented by drilling. The bird's insect diet is practically all in its favor, and in eating weed seed it confers a decided benefit on the farmer. It should be ranked

as one of our useful species, and protected by law and by public opinion.[a]

JAY FAMILY.

The jays have acquired a questionable reputation owing to the fact that they pilfer the nests of other birds and prey upon the farmer's crops. That at times they are guilty of both of these sins can not be denied. On the first of these counts the California jay is far more culpable than its eastern relative and does entirely too much nest robbing for the best interests of the State. It is also a despoiler of fruit in its season, and in this respect should be restrained. On the other hand, jays are conspicuous and ornamental elements in the bird fauna, and inasmuch as they consume many harmful insects, should not be wholly condemned.

Some half dozen species and subspecies of jays occur in California. The food of the two most important species is discussed in the following pages.

STELLER JAY.

(*Cyanocitta stelleri frontalis* and *carbonacea*.)

The Steller jay inhabits the mountains and forested areas of California throughout the year. It sometimes ventures to the edges of the valleys and occasionally visits orchards for a taste of fruit, of which it is very fond, but in general it keeps to the hills and wilder parts of the canyons. It is fond of coniferous trees and is likely to be found wherever these abound. Where ranches have been established far up the canyons among the hills, this jay visits the ranch buildings. While it has all the characteristics of the jay family, it is rather more shy than either the California jay or the eastern bluejay.

To determine the nature of the food of this species, 93 stomachs were available. They were distributed over the whole year except February and April. The contents consisted of animal food to the extent of 28 percent, and vegetable matter 72 percent.

Animal food.—Beetles amount to a little more than 8 percent: Carabidæ were found in 8 stomachs; all the others were of noxious species. One stomach was half filled with a species of weevil or snout beetle (*Thricolepis inornata*), of which 35 individuals were counted, and there were probably more. Hymenoptera amount to about 11 percent and are the largest item of animal food. They were found in 30 stomachs altogether, and 2 were entirely filled with them. Ants were found in only 2 stomachs. Three honey bees were identified, one in each of 3 stomachs. One was a worker, another a drone, and the

[a] For a more complete account of the food habits of the horned lark, see Bulletin No. 23, Biological Survey, U. S. Department of Agriculture, The Horned Larks and their Relation to Agriculture, by W. L. McAtee, 1905.

third indeterminate. None of the smaller parasitic Hymenoptera were identified. The greater part of this item of food consisted of wasps and wild bees, which would indicate that this bird is an energetic and expert insect catcher.

Hemiptera (bugs) are evidently not in favor with the Steller jay. They were found in but few stomachs and in small numbers and amount for the year to little more than 1 percent. Pentatomidæ, or stinkbugs, and Scutelleridæ, or shield bugs, were the only families identified. Diptera form only four-tenths of 1 percent. They were found in only 3 stomachs, taken at the same place and at the same hour. They consisted of crane flies (Tipulidæ) filled with eggs.

Orthoptera (grasshoppers and crickets) aggregate about 3.5 percent. They appeared in 28 stomachs and were the sole contents in one. Caterpillars and moths amount to a little more than 2 percent. The former were found in 17 stomachs and the latter in 2.

The following insects from the stomachs of the Steller jay were identified:

COLEOPTERA.

Sinodendron rugosum.
Dichelonycha fulgida.
Clerus sphegus.
Thricolepis inornata.

HYMENOPTERA.

Apis mellifera.

Of miscellaneous creatures, spiders were identified in 3 stomachs, raphidians in one, and sow bugs (*Oniscus*) in one; altogether they make up about one-half of 1 percent. Remains of vertebrates amount to a little more than 1 percent. They consist of hair and skin of a mammal found in one stomach, two bits of bone, probably of a frog, in one, and eggshells in 13. This last item is the worst in this jay's record, since it indicates that the bird is guilty of eating the eggs of smaller birds; but even this is not as bad as it looks. Only 6 of these egg-eating records occurred in June, the nesting month. All the rest were in September or later and were probably old shells picked up in abandoned nests or about ranch buildings or camp grounds.

Vegetable food.—The vegetable food may be divided into fruit, grain, mast, and miscellaneous matter. Fruit amounts to 22 percent and was found in 55 stomachs. Prunes were identified in 2 stomachs, cherries in 2, grapes in 2, Rubus fruits in 15, strawberries in 1, elderberries in 15, bay laurel fruit in 1, unknown wild fruit in 2, and fruit pulp, not fully identified but thought to be of cultivated varieties, in 16 stomachs. Thus 38 stomachs held fruit supposed to be cultivated. This number includes all containing Rubus fruits, which probably were not all cultivated—perhaps none of them were. The Steller jay undoubtedly eats considerable fruit, but most of its range lies in unsettled areas, and it is too shy to visit orchards, except those close to the

timber. For the present, then, or until it becomes more domestic, the damage to cultivated fruit is likely to be small.

Grain amounts to 5 percent, and was found in 15 stomachs, distributed as follows: Wheat in 7, oats in 9, and barley in 1. Much of the wheat was damaged, and, in fact, owing to the times of year, it could not have been otherwise. The greatest amount of grain was taken in June, 24 percent, and was probably picked up in the harvest field. Many of the oats, perhaps all, were of the wild variety. The chief food of this jay, however, is acorns, though occasionally it eats other nuts or large seeds. Mast amounts to 42.5 percent of the yearly diet, and was found in 38 stomachs. In some of them it reached 99 percent of the contents. In October and November it amounted to 76 percent, in December to 90, and in January to 99 percent. Even in June, when other food was abundant, it was eaten to the extent of nearly 10 percent, though none was found in the stomachs taken in May or July. Very likely a considerable part of this was stolen from the stores of the California woodpecker, for it is hardly probable that the jays find acorns under the trees so late as June and so early as August. It is true the jays themselves store up nuts to some extent, but hardly on the scale indicated by the contents of their stomachs when the acorn harvest is long past. Seeds, galls, and miscellaneous matter make up the remainder of the vegetable food, about 2.5 percent. In two stomachs taken near the ocean were tangles of confervæ and other seaweeds.

SUMMARY.

From the foregoing analysis it will be seen that the food of the Steller jay is of minor importance from an economic point of view. In destroying beetles and Hymenoptera it performs some service, but it destroys only a few. Of the order of Hemiptera, which contains most of the worst pests of the orchardist and farmer, it eats scarcely any. The Orthoptera, which are almost all harmful insects, are eaten only sparingly, and the same applies to the rest of the insect food. The destruction of birds' eggs is the worst count against the jay. But none were found, except in June, until September, when it was too late in the season for fresh eggs to be obtainable. In June 17 birds were taken, and 6 of them, or 35 percent of the whole, apparently had robbed birds' nests. Now, it is evident that if 35 percent of all the Steller jays in California each rob one bird's nest every day during the month of June the aggregate loss is very great.

So far as its vegetable food is concerned, this bird does little damage. It is too shy to visit the more cultivated districts, and probably will never take enough fruit or grain to become of economic importance. The other vegetable food it consumes is entirely neutral from the economic standpoint.

CALIFORNIA JAY.

(*Aphelocoma californica.*)

The California jay (Pl. III) occupies the warm chaparral-covered lower slopes of the Sierra Nevada and Coast ranges and adjacent valleys. He has the same general traits of character as the eastern jay, is the same noisy, rollicking fellow as that bird, and in California occupies a corresponding position in bird society. While for the most part a frequenter of woods and chaparral, he is by no means shy of visiting orchards and gardens, and will come even to the farm buildings if anything there interests him. A nest of the chipping sparrow (*Spizella passerina arizonæ*), which was being watched for notes on feeding, was robbed of its four nestlings early one morning by a jay, although not more than 30 feet from the front door of a house on the edge of the village. He is a persistent spy upon domestic fowls and well knows the meaning of the cackle of a hen. A woman whose home was at the mouth of a small ravine told the writer that one of her hens had a nest under a bush a short distance up the ravine from the cottage. A jay had found this out, and every day when the hen went on her nest the jay would perch on a near-by tree. As soon as the cackle of the hen was heard, both woman and bird rushed to get the egg, but many times the jay reached the nest first and secured the prize. A man living in the thickly settled outskirts of a town said that jays came every morning and perched on some large trees that overhung his barnyards, where the hens had their nests, and that it was necessary for some member of the family to be on the lookout and start at the first sound of the hen's voice or a jay would get the egg.

A still worse trait of the jay was described by a young man engaged in raising poultry on a ranch far up a canyon near wooded hills. When his white leghorn chicks were small, the jays would attack and kill them by a few blows of the beak, and then peck open the skull and eat the brains. In spite of all endeavors to protect the chicks and to shoot the jays, his losses were serious.

As a fruit-eater the jay has few equals. He has a pronounced taste for cherries and prunes, and where orchards of these fruits are near natural coverts, he will work unceasingly to carry off the fruit. The writer remained in a cherry orchard in such a situation from 9 a. m. to 4 p. m. on several occasions during the cherry season, and there was not an hour of that time that jays were not going away with fruit and coming for more, in spite of the fact that every one was shot that was unwary enough to give the collector a chance. A small prune orchard on some bottomland, just where a small ravine debouched from the wooded hills, was also watched. The fruit was just ripening, and a continuous line of jays was seen pass-

ing from the hills down through the ravine to the orchard, while a return line, each jay bearing a prune, was flying up the ravine to the woods, where, probably, the fruit was secreted and left to rot. The jay habitually stores nuts and grain for future use, and no doubt, urged by a misdirected instinct, lays up fruit for the same purpose, but with a different result. Several hours later the jays were still at work. On another occasion 7 jays were shot successively from a prune tree loaded with fruit, and others continued to come, unterrified by the report of the gun or the dead bodies of their comrades that lay on the ground beneath the tree.

The jay is also a notorious pilferer of nuts, notably almonds and English walnuts. He is a skillful nutcracker, and extracts the kernel deftly by holding the nut between his feet on a branch, while he hammers it with his beak until he cracks the shell. Only the hardest nuts defy his powers. A gentleman who owned a large ranch situated in a canyon and on the surrounding hills planted a dozen or more almond trees to raise nuts for home use. When the trees came to bearing, the jays each year carried all the nuts away before they were ripe. "Although," said the owner, "the trees bear a fair crop, I never get a nut; the jays take them all." Another gentleman had a number of very large English walnut trees on his ranch, which was at the upper end of a wooded canyon. While these nuts were yet unripe, the jays destroyed a great many. Fortunately, when mature, they seem to be too hard for the jays to peck through, so the bulk of the crop was saved.

But the jays do not frequent orchards entirely for fruit. During May and June the writer many times visited an apple orchard, the leaves of which were badly infested with a small green caterpillar, locally known as the canker worm. When a branch is jarred, these insects let themselves down to the ground on a thread spun for the purpose. Many jays were seen to fly into the orchard, alight in a tree, and then almost immediately drop to the ground. Observation showed that the caterpillars, disturbed by the shock of the bird's alighting on a branch, dropped, and that the birds immediately followed and gathered them in. These caterpillars were found in the stomachs of several jays, in one case to the extent of 90 percent of the contents.

For the laboratory investigation of the food of the California jay, 326 stomachs were used. They were distributed through every month, but the greater number were taken from May to September, inclusive. As many of them as possible were collected about orchards, gardens, ranch buildings, and stock yards. In the first analysis the food divides into 27 percent of animal matter and 73 percent of vegetable. The greatest percentage of animal food occurs in April, when it reaches 70 percent. After that it decreases gradually to

January, when it falls to its minimum of a little less than 5 percent. Vegetable food, on the contrary, is most sparingly eaten in April and most abundantly in January.

Animal food.—As the jay is largely a ground feeder, careful account was kept of the predaceous ground beetles (Carabidæ). In May they amount to 10 percent of the food and to nearly as much in February; but in the other months they are insignificant. The total for the year is 2.5 percent. Other beetles, all either harmful or neutral, amount to a little more than 8 percent. They are eaten rather irregularly through the year. April shows the greatest consumption, nearly 31 percent, and January the least, only a trace.

Hymenoptera, in the shape of wasps, bees, and ants, amount to a little less than 5 percent. They were contained in 189 stomachs and were distributed as follows: Honey bees in 9, ants in 27, other Hymenoptera in 159. These figures illustrate the fact that a bird will eat a certain article of food very often, but in small quantities. While Hymenoptera amount to less than 5 percent of the food, they were found in nearly 58 percent of the stomachs. The honey bees, 20 in number, were found in 9 stomachs, and, what is very singular, all were workers. Birds that eat honey bees usually select the drones, but the jay appears to have chosen the workers. Fortunately he does not appear to eat many.

Hemiptera were eaten to the extent of less than one-half of 1 percent. One stomach contained 2 black olive scales (*Saissetia oleæ*). Diptera seem even less acceptable than bugs as an article of food. In July, the month of greatest consumption, there were less than 1 percent.

Lepidoptera (moths and caterpillars) amount to 2.5 percent. They were eaten in every month, mainly in the caterpillar stage. May was the month when the greatest number was eaten, nearly 10 percent. The most interesting point, however, in connection with this item of food is that 12 pupæ of the codling moth were found distributed through 8 stomachs. This is a most unexpected service from a bird of the jay's habits, and it may be said that a little work of this kind will cover a multitude of sins in other directions.

Orthoptera (grasshoppers and crickets) are eaten to the extent of 4.5 percent. Most of them were taken in July, August, and September. As usual, August stands first, with a consumption of nearly 17 percent, and one stomach contained the remains of 41 individuals. *Melanoplus devastator* was the only species identified. As the jay is, to a great extent, an inhabitant of the woods, it was natural that its stomach should contain quite a number of the brown wood cricket. A mole cricket also was found in one stomach. Orthoptera were found in 151 stomachs and formed the total food in one. When they

are eaten so often, it is surprising that they do not form a larger percentage of the food.

A few miscellaneous creatures, such as raphidians, spiders, snails, etc., form less than one-half of 1 percent of the food.

The following is a list of insects identified in the stomachs of the California jay:

COLEOPTERA.

Amara conflata.
Silpha ramosa.
Limonius fulvipes.
Perothops wittieki.
Onthophagus sp.
Diabrotica sp.
Coniontis robusta.
Blapstinus rufipes.
Sciopithes obscurus.
Balaninus sp.

HEMIPTERA.

Sinea diadema.
Saissetia oleæ.

HYMENOPTERA.

Apis mellifera.

LEPIDOPTERA.

Carpocapsa pomonella.

ORTHOPTERA.

Melanoplus devastator.

Besides the insects and other invertebrates already discussed, the jay eats some vertebrates. The remains consisted of bones or feathers of birds in 8 stomachs, eggshells in 38, bones of small mammals (mice and shrews) in 11, and bones of reptiles and batrachians in 13 stomachs. In destroying small mammals the jay is conferring an unmixed good, as practically all of them are injurious. His appetite for reptiles and batrachians, however, is unfortunate. These creatures, being mostly insectivorous, are very useful. Probably, however, their ranks are not seriously thinned by the jay. Of those eaten, 9 were lizards, one a snake, one a frog, and 2 others were batrachians, but could not be further identified. The great interest in the jay's vertebrate food, however, centers about the remains of birds and eggs. Of the 46 stomachs containing these remains, 17 were taken between the middle of May and the middle of July, and, as this period practically covers the nesting season in California, all may be considered as from the nests of wild birds robbed by the jay. The others represent either the eggs of domestic fowls or old eggshells. In the above period 95 stomachs were collected, of which 17, or 18 percent, contained eggs or remains of young birds. If we may infer, as seems reasonable, that 18 percent of the California jays rob birds' nests every day during the nesting season, then we must admit that the jays are a tremendous factor in preventing the increase of our common birds. Mr. Joseph Grinell, of Pasadena, after careful observation, estimates the number of this species in California at about

126,000. This is probably a low estimate. If 18 percent of this number, or 22,680 jays, each robs a nest of eggs or young daily for a period of sixty days from the middle of May to the middle of July, the total number of nests destroyed in California by this one species every year is 1,360,800. These figures are somewhat startling, representing as they do an enormous number of useful birds, and it is to be hoped they exaggerate the damage. For the present, however, they must stand for what they are worth. More data are necessary in order to determine fully the accuracy of the figures. Little weight attaches to the destruction of the eggs of domestic fowls by this jay, since in most cases it is easily preventable.

Vegetable food.—Aside from a few miscellaneous items, that altogether amount to less than 1 percent, the jay's vegetable food may be classed under three heads: Grain, fruit, and mast. Owing to the economic importance of this food the full tabulation is given below:

Month.	Grain.	Fruit.	Mast (acorns).	Month.	Grain.	Fruit.	Mast (acorns).
January	9.40	9.00	74.90	August	18.73	48.53	0.21
February	6.43	.....	69.14	September	24.26	19.89	31.65
March	45.50	.....	27.00	October	.29	.....	88.57
April	5.00	.....	24.75	November	.....	11.14	66.29
May	2.43	61.41	.68	December	.....	17.50	73.00
June	10.27	51.29	2.22				
July	18.42	44.94	.19	Average.	11.73	22.05	38.22

It will be seen that March holds the highest record for grain. This was probably picked up from fields newly sown. After that, not much is eaten until June, when the harvest begins. From that time on, grain is an important article of diet, and is obtained by gleaning in the harvested fields. It makes a sudden drop at the end of September, for at that time the acorn crop comes in. Grain was found in 95 stomachs, of which 56 contained oats; 34, corn; 2, wheat; 2, barley; and 1, grain not further identified. Many of the oats were of the wild variety.

Fruit was found in 270 stomachs. Of these, cherries were identified in 37, prunes in 25, apples in 5, grapes in 2, pears in 2, peaches in 1, gooseberries in 2, figs in 1, blackberries or raspberries in 71, elderberries in 42, manzanita in 4, cascara in 1, mistletoe in 1, and fruit pulp not further identified in 76. It will be noted that most of the fruit was eaten in the five months from May to September, inclusive. All found in November, December, and January was fruit pulp without seeds, evidently old fruit left on the trees. All the small fruits, as raspberries and elderberries, were taken during the summer months. The raspberries may have been either wild or cultivated, and were probably both; but in any case it is safe to say that half of the fruit eaten was of wild varieties and of no economic value.

Mast forms the largest item of the jay's food. This fact has some economic interest, since mast possesses considerable value as food for stock, especially hogs. A glance at the table will show the high percentages for the eight months from September to April inclusive, and then the sudden drop to the low rank it holds for the rest of the year. While the average consumption for the year is 38 percent, for these eight months alone it rises to nearly 57 percent, or more than half of the whole food. Doctor Merriam says that by the Indians this jay is called the oak planter. There is no doubt that all jays unconsciously aid in planting forest trees. Like the California woodpecker they habitually store up nuts and other large seeds, though unlike that bird they do not prepare storage places, but place them in forks of trees, cracks in old stumps or logs, behind loose pieces of bark, or bury them in the ground. Nuts are often dropped when being carried to a place of concealment, and sprout and grow to renew the forest.

SUMMARY.

The insect food, though small in amount, may be set down to the jay's credit. By the destruction of birds' eggs and young, it does serious mischief. Two items of its vegetable food, grain and fruit, are against the jay. In the case of grain, however, it is doubtful if much damage is done, since it is taken mostly after the harvest. If the grain taken in early spring is stolen from newly sown fields, it represents a real loss; but the jay is not known to pull up grain after it has sprouted, so that all it gets at this time must have been left uncovered, and is therefore of minor importance. After harvest it is common to see small companies of jays in fields, where they probably glean scattered kernels as well as some insects. In the matter of fruit stealing there are no extenuating circumstances. Wherever orchards are near its haunts, the jay is a persistent and insatiable fruit thief. If he took only what is necessary to satisfy the appetites of himself and family, he might be endured for the sake of his better traits. But long after his hunger is appeased, he continues to carry off fruit to store away, and thus his pilferings are limited only by his numbers and by the size of the fruit crop. Moreover, much of the fruit which he pecks is left on the tree to rot, and more falls to the ground unfit for use, except by pigs. It is fortunate that only orchards situated near the jay's usual haunts suffer severely. Those farther away are visited occasionally, but are not seriously damaged. Unlike many other birds which prey upon the earlier fruits, the jay continues his depredations as long as fruit is to be had. In an orchard closely watched by the writer it was found that when the earlier cherries were ripening, blackbirds, thrushes, orioles, grosbeaks, cedar birds, and linnets, as well as jays,

were present in numbers, but two weeks later, when the earlier varieties were gone and the later ones were ripe, hardly any smaller birds were present, while the jays were as busy as ever; and still later, at the end of the season, when the prune crop came on, jays were still taking a heavy toll.

It will thus be seen that the jay has many more bad qualities than good. In fact, from the economic point of view he has few redeeming virtues. Something may be said in his favor from the esthetic side, as he is a handsome bird, and people interested in country life would no doubt miss his familiar presence. But as the case stands there are far too many California jays. If they could be reduced to a fourth or a half of their present numbers, the remainder would probably do no serious harm. This is exactly what is likely to take place gradually as the State becomes more thickly settled and forest and chaparral lands decrease.

BLACKBIRD, ORIOLE, AND MEADOWLARK FAMILY.

(*Icteridæ.*)

The family which includes the orioles, blackbirds, and meadowlarks embraces species widely different in form, plumage, nesting habits, and food. The orioles nest in trees and obtain the greater part of their food thereon. The blackbirds nest upon low trees, bushes, or reeds, and take their food from trees to some extent, but mostly from the ground. The meadowlarks, the most terrestrial of all, nest upon the ground and obtain nearly all of their food there. Orioles eat the greatest percentage of insects, the meadowlarks eat a little less, while the blackbirds eat the least. Blackbirds rank next to sparrows as eaters of weed seeds, especially in winter.

Besides the Brewer blackbird there are in California 5 species and subspecies of redwinged blackbirds, which are so much alike that most of them can be distinguished only by ornithologists. All have practically the same nesting habits, and their food is not essentially different.

BICOLORED REDWING.

(*Agelaius gubernator californicus.*)

The bicolored redwing is distributed locally over a large part of California, but owing to its peculiar habit of building its nest directly over water, the areas it occupies are restricted. Flooded marshes and ponds overgrown with bulrushes or tules are much to its taste, affording abundant nesting sites. Such places are common in California and many are of large extent—as those on Suisun Bay and in the Sacramento and San Joaquin valleys. Among

these the bicolored redwing and his redwinged relatives find congenial quarters.

For the laboratory investigation of the food of this species, 198 stomachs were available. They were collected in every month of the year, and probably give a fair idea of the bird's food. It was found to consist of 14 percent of animal matter to 86 of vegetable. The animal food is practically all insects, and the vegetable either grain or weed seed.

Animal food.—Most of the animal food was taken in May, June, and July. May stomachs showed the maximum of nearly 91 percent. There is a sudden rise in the amount from April to May and a sudden fall from July to August. The insects composing this part of the food were distributed among several of the most common orders, but none of them appear to be specially sought after. Beetles aggregate about 5 percent. A few were predaceous ground beetles, but the most were either leaf beetles (Chrysomelidœ) or weevils. Hymenoptera, in the shape of wasps and ants, were taken very sparingly in the four months from May to August inclusive, and amount to about one-fourth of 1 percent for the year. Bugs were eaten during the six warmer months, and for the year aggregate just 1 percent. Grasshoppers constitute over 15 percent of the food in July. They are a fraction of 1 percent for the other months and average 1.5 percent for the year.

Caterpillars aggregate 5.5 percent, the highest of any item of animal food. In May they amount to over 45 percent of the food of that month, which is more than for all the other months together. Probably they are fed largely to the nestlings, as a few taken in May had eaten a large percentage of these insects. It is worthy of special notice that the caterpillar known in the cotton-raising States as the cotton bollworm, and elsewhere as the corn-ear worm, *Heliothis obsoleta*, was found in 7 stomachs. This is certainly to the credit of the bird, and it may be that its visits to cornfields are for this insect primarily, and that corn is taken only incidentally. A few miscellaneous insects amount to less than 1 percent and complete the animal portion of the diet.

The following are the insects identified in stomachs of the bicolored redwing:

COLEOPTERA.

Elaphrus ruscarius.
Gastroidea cyanea cæsia.
Chætocnema minuta.
Systena ochracea.
Notoxus alamedæ.
Apocrypha dyschirioides.

LEPIDOPTERA.

Heliothis obsoleta.

Vegetable food.—Two prominent constituents make up the vegetable food of the redwing—grain and weed seed. Grain amounts to 70 and weed seed to 15 percent. The grain consists of corn, wheat, oats, and barley. Oats are the favorite. They amount to over 47 percent of the yearly food, and were eaten in every month except February, when they were replaced by barley. The month of maximum consumption was December, when nearly 72 percent was eaten, but several other months were nearly as high. Wheat stands next to oats in the quantity eaten, nearly 13 percent. It is taken quite regularly in every month except March and May. Barley was found only in stomachs taken in February, October, and November, and nearly all of it was taken in February. The average for the year is 5.5 percent. Corn is eaten still less than barley, and nearly all was consumed in September, when it reached nearly 46 percent of the month's food. A little was eaten in May, August, and October, but the aggregate for the year is only slightly more than 4 percent.

Weed seed amounts to 15 percent of the food of the bicolored redwing. It is eaten in every month except May, when it gives way to animal food. The following species were identified:

Sunflower (*Helianthus* sp.).
Tarweed (*Madia sativa*).
Bur clover (*Medicago denticulatum*).
Alfilaria (*Erodium cicutarium*).
Red maids (*Calandrinia menziesi*).
Pigweed (*Amaranthus retroflexus*).
Chickweed (*Stellaria media*).
Catchfly (*Silene* sp.).
Smartweed (*Polygonum*).
Sorrel (*Rumex* sp.).
Canary seed (*Phalaris caroliniana*).
Sedge (*Carex* sp.).

These seeds were eaten very regularly throughout the year. The greatest consumption is in March, 35 percent, but as the record for several other months does not fall much below, probably this has no special significance. All of the above weeds are more or less of a nuisance, though at times some of them may be used as forage plants. Fruit is not eaten by the bicolored redwing.

Food of young.—Among the stomachs of the bicolored redwing were 11 of nestlings varying in age from 4 days to 2 weeks. The food was made up of 99 percent of animal matter and 1 percent of vegetable, though most of the latter was mere rubbish, no doubt accidental. Caterpillars were the largest item, and amounted to an average of 45 percent. Beetles, many of them in the larval state, stood next, with 32 percent. Hemiptera, especially stinkbugs and leafhoppers, amounted to 19 percent. A few miscellaneous insects and spiders made up the other 3 percent. It will be noted that the food of the young is practically all animal and that a preponderance of caterpillars and beetle larvæ makes it softer than that of the adults.

SUMMARY.

In summing up the facts relating to the food of the bicolored redwing, the most prominent point is the great percentage of grain. Evidently if this bird were abundant in a grain-raising country it would be a menace to the crop. But no complaints of the bird's depredations on grain have been made, and it is significant that the grain consumed is not taken at or just before the harvest, but is a constant element of every month's food. As the favorite grain is oats, which grows wild in great abundance, it must be admitted that, with all its possibilities for mischief, the bird at present is doing very little damage. So far as its insect food goes, it does no appreciable harm and much good. Its consumption of weed seed is a positive benefit. Like the other redwings, it has interesting habits and a pleasant song, and for the present, at least, should be protected.

OTHER REDWINGS.

In addition to the stomachs of the bicolored redwing, a few of 2 other species of redwings have been examined. They comprise 16 stomachs of the tricolored redwing (*Agelaius tricolor*), and 12 of the western redwing (some form of *A. phœniceus*). From the examination of so small a number, final data on the food can not be obtained, but so far as the testimony goes, it indicates that both species consume more insects and less grain than the bicolored. The stomachs of the tricolored contain 79 percent of animal matter to 21 of vegetable. The animal matter consists mostly of beetles and caterpillars, with a decided preponderance of caterpillars. The vegetable food is nearly all weed seed. One stomach alone contained barley.

In the case of the western redwings, the animal food amounted to 63 percent to 37 of vegetable. The former was pretty evenly distributed among beetles, grasshoppers, and Lepidoptera (moths and caterpillars), and contained in addition a few aquatic insects. The vegetable food was largely weed seed. A little barley was found in one stomach, and one was filled with oats.

It is evident from the foregoing that the beneficial greatly outweigh the injurious elements in the food of these redwings.

BREWER BLACKBIRD.

(*Euphagus cyanocephalus.*)

The Brewer blackbird (Pl. IV) occurs over most of the cultivated districts of California. By choice it is a resident of fields, meadows, orchards, and about ranch buildings and cultivated lands generally. It takes the place on the Pacific coast occupied by the crow blackbird (*Quiscalus quiscula* and *æneus*) in the Mississippi Valley and farther

east, and is so similar in appearance and habits that the eastern observer in California forgets that it is not the same species. It nests in bushes, weeds, and sometimes in trees, and is so gregarious that several nests are often built in the same vicinity. Large colonies frequently establish themselves near farm buildings, and feed freely in the stock yards and cultivated fields. When fruit is ripe these blackbirds do not hesitate to take a share, and they visit the orchard daily for the early cherries.

They claim a share of grain also, but do not appear to eat it at harvest time so much as afterwards. Mr. Walter K. Fisher, writing from Stockton, Calif., on November 12, 1897, reports them as feeding on newly sown wheat that had not been harrowed in, eating nearly all thus left exposed. He describes the birds as in such immense flocks in the grain fields that at a distance they looked like smoke rising from the ground, and says that stomachs of birds taken were full of wheat. On the other hand, Prof. A. J. Cook, of Claremont, Calif., says that he considered it one of the most valuable species in the State; and Mr. J. F. Illingsworth, of Ontario, Calif., in a paper read before the Pomona Farmers' Club,[a] speaks of it as a beneficial bird, which should be protected. Mr. O. E. Bremner, State horticultural inspector, in a letter to the Biological Survey, says:

> The cankerworm episode is quite a common one with us here. In one district, Dry Creek Valley, Sonoma County, there has been a threatened invasion of the prune trees by spring cankerworms several times, but each time the blackbirds came to the rescue and completely cleaned them out. I have often seen bands of blackbirds working in an infested orchard. They work from tree to tree, clearing them out as they go. If a worm tries to escape by webbing down, they will dive down and catch him in mid-air.

During the cherry season the writer observed these birds in the orchards, and collected a number of them. They were seen to eat freely of cherries, and the stomachs of those taken showed that a goodly proportion of the food consisted of cherry pulp. While these observations were being made, a neighboring fruit raiser began to plow his orchard. Almost immediately every blackbird in the vicinity was upon the newly opened ground, and many followed within a few feet of the plowman's heels in their eagerness to get every grub or other insect turned out by the plow. On another occasion an orchard was being watched while the far side was being plowed. A continual flight of blackbirds was passing in both directions over the observer's head, and practically all of them alighted on the newly plowed ground, fed there for a while, and then returned, probably to their nests. When plowing was finished and harrowing began, the blackbirds immediately changed their foraging ground, and followed the harrow as closely as they had accompanied the plow.

---

[a] Ontario Observer, June 3, 1899.

In the laboratory investigation of this bird's food 312 stomachs were available. They were collected in every month in the year, and represent fairly the fruit and grain growing sections of the State from Santa Rosa southward. Many were taken in orchards and gardens when in the act of pilfering fruit or other products of husbandry. Besides adults, 29 nestlings of various ages are represented. The first analysis of the stomach contents gives 32 percent of animal matter to 68 of vegetable. The animal food consists of insects, spiders, sow bugs, snails, and eggshells.

Animal food.—The animal food attains its maximum in April, when it reaches 82 percent. From that time it slowly decreases until December, when it is only 5 percent, and then rises toward its maximum. The increase is very sudden from March to April. Beetles constitute over 11 percent of the food, and of these 2.5 percent are predatory ground beetles (Carabidæ). April is the month of greatest consumption of beetles, 29 percent, but no carabids are eaten in this month. In June 22.5 percent of beetles are eaten, of which 12 percent are carabids. The amounts eaten in other months are insignificant. The great bulk of the beetles eaten are the darkling beetles (Tenebrionidæ), which have much the same habit of living on the ground as the carabids, and are probably more abundant in California. One stomach was entirely filled with them. A few click beetles (Elateridæ) and some weevils were also eaten.

Hymenoptera (wasps, bees, and ants) were eaten to the extent of 1.7 percent of the food. Evidently blackbirds are too slow to catch often such agile creatures as wasps and bees. Hymenoptera were eaten in every month from March to November, inclusive. In June they amount to something over 7 percent, which is the maximum.

Bugs (Hemiptera) of various kinds are eaten from April to November to a small extent. They aggregate somewhat more than 1 percent for the year. In the month of greatest consumption, June, they reach only 5.5 percent. They belong mostly to the families of stinkbugs (Pentatomidæ) and shield bugs (Scutelleridæ). A black olive scale was found in one stomach. Flies (Diptera) were eaten to a slight extent from April to July inclusive, with a trace in October. The total for the year is only a little more than 1.5 percent. Like bees and wasps, flies are probably too quick to be easily caught.

Caterpillars and pupæ (Lepidoptera) reach the highest percentage of any item of animal food. They amount to nearly 12 percent, and are eaten in every month. April is the month when most are taken, over 38 percent, and the record for May stands nearly as high. They belong largely to the owlet moths (Noctuidæ), which comprise many of those pests generally known as cutworms. The cotton bollworm, or corn-ear worm (*Heliothis obsoleta*), was identified in 10 stomachs, and was probably contained in many more, but in a condition that

baffled recognition. The most interesting Lepidoptera were the pupæ of the codling moth, found in 11 stomachs, 4 of which belonged to adults, while the other 7 were from nestlings, whose food will be discussed farther on. An orchardist told the writer that at one time his trees became infested with cankerworms, which swarmed all over the orchard and were rapidly destroying the leaves, when the blackbirds came in great numbers from all quarters and fed upon the worms until they were practically exterminated.

Grasshoppers and crickets were taken from April to November, inclusive, and amount for the whole year to 3.5 percent of the diet. In June they constitute over 15 percent of the food of that month, but only a moderate percentage was eaten in the other months. It is rather remarkable that birds which feed so much on the ground should eat so few of these insects, but this species appears to be mainly a vegetable eater, and to get the larger part of its animal food in April, just at its reproductive season, before grasshoppers are abundant.

Following is a list of insects identified in the stomachs of the Brewer blackbird:

COLEOPTERA.

Triæna scitula.
Triæna longula.
Bradycellus rupestris.
Scymnus lacustris.
Dermestes mannerheimi.
Saprinus obscurus.
Anchastus cinereipennis.
Aphodius rugifrons.
Aphodius granarius.
Diabrotica soror.
Diachus auratus.
Gastroidea sp.
Blapstinus pulverulentus.
Blapstinus rufipes.
Apocrypha dyschirioides.
Anthicus punctulatus.
Sitones sp.

HEMIPTERA.

Saissetia oleæ.

LEPIDOPTERA.

Heliothis obsoleta.
Carpocapsa pomonella.

Vegetable food.—The vegetable food reaches its maximum of 95 percent in December, when animal food is least plentiful. It may be divided into fruit, grain, and weed seed. Fruit was eaten in May, June, and July, not a trace appearing in any other month. It was found in 63 stomachs, of which 37 contained cherries (or what was thought to be such); 2, strawberries; 3, blackberries or raspberries; and 21, fruit pulp or skins not further identified. The percentages for each month were 14 for May, 22 for June, and 15 for July, an average of 17 percent for each of the three months, or of a little more than 4 percent for the whole year. This certainly is not a bad showing, and if the bird does no greater harm than is involved in its fruit eating, it is well worth protecting.

Grain constitutes 54 percent of the yearly food of the Brewer blackbird. It is eaten in every month, and forms a respectable percentage in each. The greatest amount is taken in December, 93 percent, and the least in April, 4 percent. Oats are the favorite grain. They amount to nearly 46 percent, and were found in 157 stomachs. Wheat amounts to nearly 3 percent, and was contained in 11 stomachs. Corn ranks next as to quantity eaten, less than 2 percent, but it was found in 17 stomachs. Barley occurred in only 5 stomachs, but amounted to a little more than 2 percent. Only 1 stomach held rye, but it amounted to more than 1 percent, for the stomach was nearly filled with it. Oats were the sole contents of 14 stomachs and wheat of 2. No stomach was completely filled with any other grain. Oats are evidently the favorite grain, whether we judge by the percentage eaten or by the number of stomachs containing them. Many of these were wild oats and of little economic value.

Weed seed amounts to nearly 9 percent of the food, and, while not consumed in large quantities, is eaten to some extent in every month. The greatest amount is taken in March, 26 percent. October comes next, with nearly 16 percent. The least is eaten in December and January, when grain is at its highest point. But little weed seed is eaten in May and June, when cherries demand attention. Weed seed was found in 134 stomachs, but in rather small quantities in each. No stomach was completely filled with it. It seems to be taken, moreover, rather irregularly, as though it were merely a makeshift. A few other odd items, mostly rubbish, amount to less than 1 percent, and complete the quota of vegetable food.

Seeds of the following uncultivated plants were identified:

Lesser tarweed (*Hemizonia fasciculata*).
Tarweed (*Madia sativa*).
Bur thistle (*Centaurea melitensis*).
Alfilaria (*Erodium cicutarium*).
Black mustard (*Brassica nigra*).
Miners' lettuce (*Montia perfoliata*).
Red maids (*Calandrinia menziesi*).
Pigweed (*Amaranthus retroflexus*).
Spurry (*Spergula arvensis*).
Chickweed (*Stellaria media*).
Catchfly (*Silene* sp.).
Knotweed (*Polygonum* sp.).
Brome grass (*Bromus* sp.).
Wild oats (*Avena fatua*).
Monterey pine (*Pinus radiata*).

Food of young.—Among the stomachs examined were those of 29 nestlings, varying in age from twenty-four hours to some that were nearly fledged. Taken altogether, the stomachs contained 89 percent of animal matter to 11 of vegetable. Over 74 percent of all was composed of caterpillars, grasshoppers, and spiders. Beetles in general amount to 6 percent of the food, or a little more than half the quantity eaten by the adults. Very singularly, however, 4.5 percent of these are carabids, or predatory ground beetles, nearly twice as many as are taken by the parent birds, although soft food is usually preferred for feeding nestlings. Caterpillars, with a few

adult moths and some pupæ, aggregate 33 percent, which is three times as many as were eaten by the old birds. They were found in 22 of the 29 stomachs. The most interesting part of this item is 15 codling moth pupæ that were contained in 7 stomachs. Four adult stomachs also contained one each of these pupæ, but they seem to be mostly reserved as tidbits for the young. Grasshoppers and crickets were found in 21 stomachs, and aggregate 30 percent of the food, more than eight times as much as was eaten by the adults, so these insects also are evidently reserved for the nestlings. Spiders amount to 11 percent of the food of the young, although less than 1 percent of the parents' food. Various other insects and a few snails make up the rest of the animal food.

The vegetable food consists of fruit, grain, and rubbish. Fruit, probably cherries, was found in 4 stomachs of one brood. The average for each stomach was 43 percent. This was the oldest brood taken, and the birds were nearly ready to fly, which probably accounts for the large proportion of vegetable food. Oats, found in the stomach of one bird about a week old, amounted to about 45 percent of the contents, and seemed unusual food for so young a bird. The other two of the same brood had grass and other rubbish in their stomachs. Rubbish is the best term to describe the vegetable matter in most of these stomachs. The fruit and grain were all that should be called food.

One can not fail to notice the very pronounced difference in diet between these nestlings and the adults. Not only is the animal food of the young greatly in excess, but it is practically made up of spiders, caterpillars, and grasshoppers. All of these are comparatively soft-bodied creatures, and probably on that account are selected for the young.

SUMMARY.

In so far as its animal food is concerned, but little fault can be found with the Brewer blackbird. The insects eaten are fairly well distributed among the various orders, and include only a comparatively small number that are useful. As to fruit, no more is eaten than may be considered a fair return for the destruction of insects. The weed seed eaten must be set down to the bird's credit. All question, then, in regard to its economic position must rest upon the grain it eats. Most of the grain is taken in the months from August to February, inclusive. The average amount consumed in those seven months is over 75 percent of the food, while the average for the other five months is less than 24 percent, yet this last period covers the time from sowing to the end of harvest. As matters stand at present, probably the bird is doing no harm by eating grain, except perhaps under exceptional circumstances. It has a decided

proclivity for oats, and if abundant would undoubtedly prove a menace to the crop.

WESTERN MEADOWLARK.

(*Sturnella neglecta.*)

Throughout California wherever grassy uplands, fields, and meadows occur, there will be seen the western meadowlark. Low, rich meadows, verging to marsh, with water near by, form ideal conditions for this bird. Nor does it disdain fertile hillsides when not too high, and when covered by a thick coat of herbage. Only professional ornithologists take note of the plumage differences between the eastern and western species of the meadowlark, but the difference in song is evident to the dullest ear. Owing to the snow, meadowlarks in the northern and eastern parts of the United States must migrate in winter far enough south to find open ground, but in California valleys no such necessity exists; so the bird remains on the same range the year round, and carries on its good work of destroying insects and weeds.

A few complaints have been made that meadowlarks in California eat the seeds of forage plants, notably clover, to an injurious extent. As most of the forage plants, including the introduced grasses of the Pacific coast lowlands, are annuals, the destruction of their seed would lessen the next season's feed and be a damage. Probably, however, such harm is done only under exceptional circumstances, for the stomachs show only a very small percentage of seed of forage plants and no clover seed. Another report is that the meadowlark does considerable damage to peas. The earliest fields are most visited by the birds, and small patches are sometimes almost completely destroyed. The later crops are not so badly damaged, and in extensive areas the loss is hardly noticeable. All the reports of damage to peas thus far received are from southern California, and very likely the explanation lies in some peculiar local conditions. The birds evidently lose their taste for this kind of food before the season is over, and probably find something more palatable which is wanting at first.

In some parts of the San Joaquin Valley the meadowlark has been accused, and probably with good reason, of pulling up sprouting grain in early spring. It is stated that the bird bores down beside the new plant and draws out the kernel. In many cases the amount of grain thus destroyed is said to be large. In one instance it was stated that the crop over a limited area was reduced 50 percent. The evidence, however, is conflicting, as some grain growers in the same localities are not aware of any loss. It thus seems probable that the damage to grain by the meadowlark is limited in extent and very local.

For the determination of the food of the meadowlark 91 stomachs were available, distributed throughout the year. The food consists of 70 percent of animal matter to 30 of vegetable. Broadly speaking, the animal matter is made up of insects and the vegetable of seeds.

Animal food.—Beetles are the largest item of the animal part of the diet. They are evidently a favorite food, for they are eaten in every month, with a good percentage in nearly all of them. The amount for the year is almost 27 percent. Practically half of this consists of the predatory ground beetles (Carabidæ). It is not surprising that the meadowlark should eat these beetles, for nearly all of them live on the ground, and walk and run much more than they fly; hence they are easily taken. As nearly all the species subsist largely upon other insects, their destruction must be considered as a flaw in this bird's record. All the other beetles eaten are harmful or neutral, and include a number of weevils. One stomach contained 36 yucca weevils (*Rhigopsis effracta*). The greatest number of beetles appears to have been eaten in March, when they amount to 72 percent, but as only two stomachs were available for that month the record is unreliable.

Wasps and ants (Hymenoptera) aggregate nearly 6 percent. They were eaten in every month but two, and ample material would undoubtedly show them in every month. Ants, being the more terrestrial, seem to be more natural food for the meadowlark than wasps or bees, but the bird gets a good share of both. Bugs (Hemiptera) were eaten to the extent of a little more than 4 percent. Nearly all of them were stinkbugs (Pentatomidæ). They were not eaten very regularly, and several months were not represented. May was the month of greatest consumption, 27 percent, but this may have been accidental.

Lepidoptera, largely caterpillars, aggregate about 15 percent. They were eaten in every month except August, when they were replaced by grasshoppers. February is apparently the month of maximum consumption, but a greater number of stomachs might prove differently. It is thought that many of these are of the kinds known as cutworms, though none were positively identified. All were undoubtedly terrestrial species, for the meadowlark is not known to seek food anywhere but on the ground.

Grasshoppers, when abundant, are usually eaten very freely by all ground feeding birds and by many arboreal species. The western meadowlark eats them to the extent of something more than 12 percent of its yearly food. This is a very small percentage for a bird of such terrestrial habits. The eastern form eats them to the extent of 29 percent, and in August the amount taken reaches 69 percent of the food of that month. With the western species the consumption reaches 42 percent in August, which is the maximum

for the year. In the East the grasshopper season is limited to five months at most, but in California these insects can always be found. This makes it all the more surprising that California meadowlarks do not eat them more freely, but it is noteworthy that nearly every species of terrestrial bird in the East eats a larger percentage of these insects than does the related species on the Pacific coast. The actual percentage of grasshoppers proper eaten by the western meadowlark is even less than the above figures indicate, for the record includes quite a number of crickets, both the black and the brown or wood crickets (*Stenopelmatus*). One stomach contained 12 wood crickets. Crane flies (Tipulidæ), spiders, sowbugs (*Oniscus*), and a few snails make up the rest of the animal food, nearly 6 percent. More than half of this item consists of the crane flies (daddy longlegs) found in one stomach taken in April, in which they amounted to 45 percent of the stomach's contents.

The following insects were identified in the stomachs of the western meadowlark:

COLEOPTERA.

Calosoma externum.
Trixna longula.
Silpha ramosa.
Dolopius lateralis.
Taphrocerus gracilis.
Eurymetopon cylindricum.
Blapstinus dilatatus.
Rhigopsis effracta.
Sitones hispidulus.

ORTHOPTERA.

Stenopelmatus sp.

Vegetable food.—The vegetable food of the western meadowlark may be arranged under three heads: Fruit, grain, and weed seed. In one stomach taken in November was found something which was doubtfully identified as fruit pulp, but no other stomach contained a trace of fruit, and this bird has rarely been accused of eating fruit.

From August to March inclusive, grain is one of the most important articles of food. The average monthly consumption for the year is 27.5 percent, but for the eight months just indicated the average is 41 percent. In the other four months, that is, from April to July inclusive, which include the ripening and harvesting of the crop, no grain except a little corn was eaten. Grain of some kind was found in 60 of the 91 stomachs, and 4 were entirely filled with it. Corn is eaten only occasionally, and amounts to but 1 percent of the food. It was all taken in May and June. Wheat was eaten from October to January, inclusive. It amounts to over 11 percent for those months, but to less than 4 percent for the whole year. As is usual with grain eating birds, oats are the favorite kind. They were eaten from August to March inclusive, and average nearly 33 percent for those eight months, and for the year a little less than 22 percent. The greatest quantity, nearly 57 percent, was eaten in January, but

nearly as much was taken in September. March, the month of seeding, shows the least, 10 percent. Barley was found in 6 stomachs taken in November, and amounts to less than 1 percent for the year.

Weed seed forms only 2 percent of the yearly food of the western meadowlark. With the eastern bird it aggregates a little more than 11 percent. It seems strange that a bird which obtains its food from the ground, and whose vegetable diet consists so largely of seeds, should neglect a food that furnishes sustenance to so many other species of birds. Weed seed was eaten so irregularly as to indicate that it was taken only as a makeshift. December was the month of greatest consumption, when it amounted to 15 percent.

SUMMARY.

Three items of damage may be brought up against the meadowlark. The first is the destruction of predaceous ground beetles (Carabidæ), which amount to one-eighth of its food. This, however, constitutes but a small offense when we consider the number of caterpillars and grasshoppers which the bird also destroys. The damage to peas and grain when sprouting are undoubtedly real and in some cases serious, but the conflicting testimony in regard to these points indicates that this damage is due to local conditions, and it is probable that a careful study of the attendant circumstances will lead to a remedy.

In some communities, especially in the South and West, where meadowlarks are most abundant, there is a tendency to include them among game birds. The tiny body of the meadowlark, however, has slight food value as compared with the value of the living bird to the agriculturist. While the western meadowlark can not be classed in the front rank of the proved friends of the farmer, its services are sufficiently real and important to earn protection wherever it is found.

BULLOCK ORIOLE.

(*Icterus bullocki.*)

Over most of the plains and valleys of California, where trees are available for nesting and foraging, the Bullock oriole (Pl. V.) is a common summer visitant. In the West it takes the place occupied in the East by the Baltimore oriole. In food, nesting habits, and song the birds are similar. Both are migratory and remain on their summer range only about five or six months. They are rather domestic in habits, and take kindly to orchards, gardens, and the vicinity of farm buildings, and often live in villages and in the parks of large towns. Their diet is largely made up of insects that infest orchards and gardens. Their favorite foraging places are trees, where they may be seen examining every leaf in search of their customary food,

caterpillars and other leaf-haunting insects. When fruit trees are in bloom they are constantly busy among the blossoms, and probably save many of them from destruction.

For the investigation of the food of the Bullock oriole 162 stomachs were available. They were taken in the five months from April to August inclusive, and probably give a very fair idea of the food for those months. Analysis of the contents shows about 79 percent of animal matter to 21 of vegetable.

Animal food.—The animal food consisted mainly of insects, with a few spiders, a lizard, a mollusk shell, and eggshells. Beetles amounted to 35 percent, and all except a few ladybugs (Coccinellidæ) were harmful species. The coccinellids were found in 9 stomachs, but the percentage was insignificant. Many of the beetles were weevils, and quite a number belonged to the genus *Balaninus*, which lives upon acorns and other nuts. Ants were found in 19 stomachs, and 1 contained nothing else. Hymenoptera other than ants were found in 56 stomachs, and entirely filled 2 of them. Including the ants, they amount to nearly 15 percent of the food of the season. The month of maximum consumption was April, when they reached over 29 percent of the monthly food.

One of the most interesting articles of food in the oriole's dietary is the black olive scale (*Saissetia oleæ*). This was found in 45 stomachs, and amounted to 5 percent of the food. In one stomach these scales formed 87 percent of the contents; in another, 82; and in each of two others, 81 percent. In one of these 30 individual scales could be counted. Scales were evidently a standard article of diet. They were eaten regularly in every month of the oriole's stay except April. Hemiptera other than scales are eaten quite regularly. They amount to a little more than 5 percent of the food. The month of greatest consumption was July, when they formed over 13 percent. They were mostly stinkbugs, leafhoppers, and tree hoppers. Plant lice (Aphididæ) were found in one stomach.

Lepidoptera, in the shape of moths, pupæ, and caterpillars, are the largest item of the oriole's animal food. April, the month of the bird's arrival from the South, is the month of greatest consumption, nearly 63 percent. The month when the fewest are taken is July, not quite 8 percent. This also is the month when the Baltimore oriole eats the fewest caterpillars. For the Bullock oriole the average consumption during its summer stay is a little more than 41 percent against 34 percent by the Baltimore. Perhaps the most interesting point in connection with the Lepidoptera is the eating of the pupæ and larvæ of the codling moth (*Carpocapsa pomonella*). These were found in 23 stomachs, which shows that they are not an unusual article of diet. No less than 14 of the pupa cases were found in one stomach, and as they are very fragile, many others may have been

present, but broken up beyond recognition. It is curious that the oriole should find these insects. During the greater part of their larval life they are concealed within the apple. When ready to pupate they crawl out and at once seek some place of concealment, such as a crevice in bark or among clods or rubbish, where they can undergo their changes. To find them, therefore, birds must hunt for them. This would be very natural work for woodpeckers, titmice, creepers, and nuthatches, but it seems a surprising habit for an oriole.

Grasshoppers probably do not come much in the oriole's way. They were eaten, however, to the extent of a little more than 3 percent. In June they rise to somewhat more than 11 percent, which is the maximum. August is the month in which most birds eat the greatest quantities of grasshoppers, but none of the orioles collected in that month had eaten any. In spite of the fact, however, that grasshoppers are eaten so sparingly, 2 stomachs, both taken in June, contained nothing else, and another had 97 percent of them.

Various insects and spiders, with a few other elements, make up the rest of the animal food, a little more than 5 percent. Spiders do not form any important percentage of the oriole's food, but are probably eaten whenever found. They were identified in 44 stomachs, but no great number appeared in any. The scales of a lizard were found in one stomach and the shell of a snail in another. Eggshells occurred in 8 stomachs, and one egg was apparently eaten when fresh.

Eggshells are often seen in birds' stomachs and in most cases are supposed to be empty shells, which have been thrown from the nest. In the examination of the stomachs of over 200 species of birds, eggshells have been found in some of the stomachs of a great majority of the species. While most of these may have been empty shells, some of the cases are very questionable, and it is probable that occasionally individuals of most species of birds yield to the temptation to eat a fresh egg when a favorable opportunity occurs.

Vegetable food.—Practically all of the vegetable food consists of fruit, which amounts to a little more than 9 percent. Other vegetable matter aggregating less than 2 percent is largely rubbish, probably taken accidentally. Fruit was eaten in the four months from May to August inclusive. The maximum quantity was taken in July, when it amounted to nearly 40 percent. It was found in 67 stomachs, of which 16 contained cherries; 11, figs; 5, blackberries or raspberries; 1, elderberries; and 34, fruit pulp not further identified. One stomach was entirely filled with the pulp and seeds of figs. While this is a high percentage of fruit, most of which is of cultivated varieties, it is probably well paid for by the destruction of harmful insects. It is doubtful if any fruit grower would be willing to sacri-

fice the oriole, with its brilliant plumage and cheerful song, even if it took more fruit than it now does.

SUMMARY.

From an esthetic point of view the Bullock oriole has few rivals, and from an economic standpoint it has only one fault—that it does eat some fruit. It is not, however, so abundant that its ravages are likely ever to become serious, and its present numbers should be strictly protected.

SPARROW FAMILY.

(*Fringillidæ.*)

The sparrow family embraces a large number of birds of wide distribution, great diversity of form, and considerable variation in food habits. They are in general characterized by short, stout, conical bills, with which they hull seeds or crush beetles and the toughest skinned fruit. They are the great seed eaters of the feathered race. The quantity of seeds of noxious weeds consumed by the host of sparrows, especially in winter, is enormous. While the great bulk of the food of this family consists of vegetable matter, most of the species eat some animal food during the period of reproduction, and feed their young upon it during the first two weeks of their lives. The sparrows proper, commonly known as finches, linnets, or buntings, are, with a few exceptions, of subdued colors and quiet habits and subsist mostly upon vegetable food. On the other hand, such aberrant forms as grosbeaks and towhees eat a certain amount of animal food throughout the year.

In California about 60 species and subspecies of sparrows proper have been recorded, besides about a dozen grosbeaks and towhees. Not all of these, however, have such habits as render them of economic importance, and as many of the subspecies do not differ essentially in their food they are treated together.

WILLOW GOLDFINCH.

(*Astragalinus tristis salicamans.*)

The willow goldfinch, while found over most of the State west of the Sierra, is very locally distributed. Its plumage is beautiful, and its song, while not remarkable for power or volume, is sweet and cheery. The western goldfinches, like the eastern, feed principally upon seeds, and seem to have a special taste for those of thistles. When one finds a ripe thistle head, he at once begins to pick out the seeds and scatter the down, at the same time making a great jubilation, as though he enjoyed the fun of seeing the down fly. This habit has earned for them the name of thistle bird. They are

eminently seed lovers, and rarely eat anything else, except a few insects during the season of reproduction. The only mischief so far imputed to them is the eating of the seeds of useful plants, such as lettuce and other vegetables on seed farms. Investigation has failed, however, to find a case where the damage was considerable. The writer visited some of the largest seed farms in California and ascertained that while birds, especially goldfinches, ate some of the ripening seeds, the damage had never been serious enough to warrant any protective measures. The writer observed goldfinches feeding on lettuce seed, but the birds were few, and all they could eat would have no appreciable effect on the quantity of seed harvested.

One marked peculiarity of the goldfinches is their bibulous habits. They seem always in need of water, perhaps owing to the habit of eating dry seeds. The writer has seen more goldfinches drinking in one day than he has seen of all other species in his whole life.

Only 84 stomachs of the willow goldfinch were available for examination, but such is the uniformity of the food that a larger number would probably not give a very different result. No stomachs were taken in December, but all the other months were represented. The food for those months amounts to 5 percent of animal matter to 95 of vegetable. All the animal food was found in 10 stomachs, 9 being taken in March, April, and May, and 1, containing 2 larvæ, in September. Practically all the vegetable matter is seeds.

Animal food.—The animal food was composed entirely of 3 orders of insects: Bugs (Hemiptera), flies (Diptera), and caterpillars (Lepidoptera). Bugs were contained in 5 stomachs and were all plant lice (Aphididæ). They aggregated a little less than 2 percent. Flies were found in 1 stomach taken in April. They were in the shape of larvæ or maggots and amounted to less than one-half of 1 percent. Caterpillars were contained in 6 stomachs and aggregated less than 3 percent. Beetles, wasps, ants, and grasshoppers, which so often constitute the bulk of the animal food of birds, are entirely wanting in the stomachs of the willow goldfinch, as also are spiders.

Vegetable food.—Vegetable matter appeared in every one of the 84 stomachs, and 73 of them held no other food. Hulls of oats were found in 1 stomach taken in May. It amounted to 65 percent of the contents of that stomach, and was the only thing of economic value found in any one of the 84 stomachs. It amounted to less than one-half of 1 percent of the year's food. Seeds of various weeds come to over 91 percent of the diet, and are found in every stomach in every month. For seven months weed seed constituted the entire food. The following plants were identified: *Centaurea* or bur thistle in 18 stomachs, alfilaria or filaree in 13, sunflower in 12, groundsel in 4, mouse-ear, rust weed, and tarweed in 2 each. As the goldfinch takes a good deal of gravel into its stomach, many of the seeds are ground

up so that recognition is impossible. A few stomachs contained a vegetable food that could not be identified, perhaps some large seed broken up and discolored. Two stomachs containing this substance were those of nestlings 12 days old. One was entirely filled with it, but the other contained 75 percent of caterpillars.

SUMMARY.

There are probably few birds that do so little harm as the willow goldfinch. Its animal food, though small in quantity, is composed entirely of harmful insects. It eats no fruit and practically no grain. Most of its food consists of the seeds of noxious or neutral plants. Its food habits commend the bird, as much as its bright plumage and fine song.

GREEN-BACKED GOLDFINCH.

(*Astragalinus psaltria hesperophilus.*)

The green-backed goldfinch (Pl. VI) occurs over most of California, except the mountains and the deserts, and is one of the most abundant birds. It is a lover of the orchard and garden, and delights to linger along the roads and in weed patches. Its favorite feeding grounds are in open pastures, where the bur thistle (*Centaurea melitensis*) grows, a plant specially adapted to the wants of the goldfinch, for it throws out from the roots short seed-bearing stalks that bear seed, while the rest of the plant is making growth and getting ready to produce the main crop. The goldfinches know where these seeds are, and apparently get every one of them. Next in favor is the groundsel (*Senecio*), which grows in orchards, and on the unripe seeds of which the goldfinches feed to repletion. In the investigation of the food of this bird 476 stomachs were examined. They were taken in every month, and are well distributed. Animal food amounts to 1.7 percent and vegetable food to 98.3.

Animal food.—Animal food was contained in 50 stomachs, all taken in the four months from June to September inclusive, except one, which was taken in November. This stomach contained 20 percent of some insect food, apparently flies. In one stomach taken in September beetles formed 1 percent of the contents. No other trace of a beetle was found. A small wasp or bee was identified in one stomach, also taken in September. It amounted to 2 percent of the contents and was the only hymenopterous insect found. Caterpillars amount to only a small fraction of 1 percent, and were contained in 2 stomachs, one taken in June and the other in July.

The great bulk of the animal food was made up of Hemiptera in the form of plant lice. These were found in 46 stomachs distributed through the four months from June to September inclusive, though more than half of them were taken in August. One stomach was

entirely filled with these insects, and in another 300 were counted. Considered in relation to the food of the year, however, they amount to only 1.6 percent. Many of these plant lice are of the kind commonly called woolly aphids, because their bodies are covered with a white cottony appearing substance, really a white wax, which exudes from the body of the insect. While the destruction of this small number of insects may seem insignificant, yet the goldfinch is one of the forces that keep within reasonable bounds the immense swarms of these prolific and pestiferous creatures. By far the greater number of these aphids were found in the crops and not in the stomachs; but as many of the latter were not accompanied by the crops, possibly the goldfinch consumes many more of these insects than is shown above. Then, too, aphids are very fragile, and by the time they reached the stomach many of them were probably too much reduced to be identified.

Vegetable food.—The vegetable food may be divided into 4 categories: Fruit, grain, weeds, and miscellaneous matter. Fruit was found in 7 stomachs, all taken in June, July, and August. In one case it was a berry with small seeds, which have not yet been identified; in the others it could be classed only as fruit pulp. Altogether it amounts to three-tenths of 1 percent of the year's food. A single kernel of wheat was found in 1 stomach taken in December. Weed seed is the standard food of this goldfinch. It aggregates over 96 percent of the year's diet, and in January and March nothing else is eaten. The month of least consumption, August, shows over 86 percent, and in every other month it is above 94. While several species are eaten freely, the chief is the Napa, or bur thistle (*Centaurea melitensis*), which was found in 243 of the 476 stomachs, and would seem to be the staff of life of the goldfinch. It is a small hard seed covered with an apparently siliceous shell, with a hook at one end and a bunch of stiff bristles at the other.[a] Generally the bird skillfully removes this shell and swallows only the starchy pulp. Many kinds of weed seed were found in the 469 stomachs examined, and only 7 did not contain any; 394 contained nothing else.

Other vegetable food, some of it not satisfactorily identified and some of it rubbish, amounts to 1½ percent of the whole. In regard to eating seeds of garden vegetables on seed farms, what was said of the willow goldfinch will apply with equal truth to this species. What seemed to be the petals of flowers were found in a few stomachs, but did not reach a respectable percentage. It does not appear that the green-backed goldfinch requires any other food than weed seed, and of this one or two varieties suffice. The following is a list

[a] Pl. II, fig. I, Part I, opp. p. 16.

of the seeds identified and the number of stomachs in which each species was found:

Sunflower (*Helianthus* sp.)	4
Lesser tarweed (*Hemizonia fasciculata*)	1
Tarweed (*Madia sativa*)	23
Mayweed (*Anthemis cotula*)	10
Groundsel (*Senecio vulgaris*)	33
Bur thistle (*Centaurea melitensis*)	243
Black nightshade (*Solanum nigrum*)	1
Turkey mullein (*Eremocarpus setigerus*)	18
Alfilaria (*Erodium cicutarium*)	9
Black mustard (*Brassica nigra*)	1
Miner's lettuce (*Montia perfoliata*)	2
Red maids (*Calandrinia menziesi*)	1
Pigweed (*Amaranthus retroflexus*)	30
Chickweed (*Stellaria media*)	3
Catchfly (*Silene* sp.)	1
Knotweed (*Polygonum* sp.)	2
Sorrel (*Rumex* sp.)	1
Sedge (*Carex* sp.)	6

SUMMARY.

If there are any faults in the food habits of the green-backed goldfinch, the writer does not know them. The little animal food it consumes consists of harmful insects, and practically all of its vegetable food consists of seeds of useless or harmful weeds. This goldfinch should be protected to the fullest extent.

INTERMEDIATE AND NUTTALL SPARROWS.

(*Zonotrichia leucophrys gambeli* and *nuttalli*.)

One or the other of these two subspecies of the white-crowned sparrow is found throughout the year in some part of California, and in winter the intermediate (*gambeli*) is distributed nearly all over the lower parts of the State. These sparrows frequent valleys, brushy hillsides, highways, and cultivated fields. The only complaint against them is that in spring and in winter they eat buds of fruit trees. Buds are usually overabundant, and the loss of some is generally a benefit to the tree; in any event it would require a very thorough disbudding to do much damage.

For the investigation of the bird's food, 516 stomachs were available, taken in every month of the year, though August was represented by only one, and May and July by two each. The first analysis gives 7.4 percent of animal matter to 92.6 of vegetable.

Animal food.—Beetles amount to 1.4 percent of the food. In June they reach nearly 8 percent, but in the other months are unimportant. Practically all of them are harmful. Hymenoptera amount to 1.9 percent. In June they reach over 16 percent, but in the other months

rise barely above 1 percent. They were contained in 66 stomachs, of which 48 held ants and 18 contained wasps and bees. Parasitic species were noted in several stomachs.

Hemiptera amount to one-half of 1 percent, and were identified in 11 stomachs, of which 5 contained black olive scales; 2, leafhoppers; 3, stinkbugs; and 1, a tree hopper. Caterpillars are the largest item of animal food and amount to about 3.5 percent. Most of them were eaten in July, when they constituted 37.5 percent of the food, but as only 2 stomachs were collected in that month, this record can not be taken as final.

Vegetable food.—Fruit amounts to 4.5 percent. It was eaten rather irregularly, but most of it from March to July, inclusive. A mere trace was found in stomachs taken in September and October. Elderberries were found in 5 stomachs, blackberries or raspberries in 3, figs in 3, cherries in 2, and in 1 a small berry not positively identified. The cherries were unripe and only partly grown. A little pulp was noticed that might have been from some larger fruit. The great bulk of it was taken in May, June, and July. Grain aggregates 8.6 percent. It was contained in 69 stomachs, as follows: Oats in 56, wheat in 7, barley in 5, and corn in 1. Most of it was eaten in the three winter months, a little in the fall and spring, but practically none in summer. Only 3.5 percent was eaten in March, which would seem to indicate that this bird does not devour the newly sown grain.

Like many other fringilline birds, white-crowned sparrows subsist largely on weed seed. It is eaten freely in every month, and amounts to 74 percent of the yearly food. June is the month of least consumption, 33 percent, but that is the month when the most insects and fruit are eaten. The 1 stomach taken in August was entirely filled with this food, and it was over 90 percent of the contents of those taken in September and October. Of the 516 stomachs only 38, or a little more than 7 percent, contained no weed seed.

Following is a list of the species identified and the number of stomachs in which each was contained:

Sunflower (*Helianthus* sp.)	3
Lesser tarweed (*Hemizonia fasciculata*)	1
Tarweed (*Madia sativa*)	34
Mayweed (*Anthemis cotula*)	75
Bur thistle (*Centaurea melitensis*)	38
Sow thistle (*Sonchus asper*)	4
Prickly lettuce (*Lactuca scariola*)	1
Nightshade (*Solanum nigrum*)	70
Senna (*Cassia* sp.)	7
Lupine (*Lupinus* sp.)	1
Clover (*Trifolium* sp.)	1
Mountain lilac (*Ceanothus* sp.)	1
Poison oak (*Rhus diversiloba*)	12
Alfilaria (*Erodium cicutarium*)	45

Geranium (*Geranium dissectum*)	18
Black mustard (*Brassica nigra*)	3
California poppy (*Eschscholtzia californica*)	1
Miner's lettuce (*Montia perfoliata*)	29
Red maids (*Calandrinia menziesi*)	4
Purslane (*Portulaca oleracea*)	4
Pigweed (*Chenopodium album*)	12
Rough pigweed (*Amaranthus retroflexus*)	208
Spurry (*Spergula arvensis*)	10
Chickweed (*Stellaria media*)	16
Catchfly (*Silene* sp.)	29
Knotweed (*Polygonum* sp.)	76
Sorrel (*Rumex* sp.)	18
Brome grass (*Bromus* sp.)	20
Wild oats (*Avena fatua*)	34
Canary seed (*Phalaris canariensis*)	2
Johnson grass (*Andropogon sorghum*)	1
Sedge (*Carex* sp.)	11
Unidentified	168

As this bird takes a great deal of gravel, the seeds eaten are soon ground into paste, which renders specific identification impossible. Many stomachs were entirely filled with food in this condition, which accounts for the large amount of unidentified material. Very few whole seeds were unidentified. The white-crown is evidently fond of variety, for several stomachs contained as many as 9 different species of seeds. It will be noted also that rough pigweed is the favorite food, while the Arkansas goldfinch preferred bur thistle.

Miscellaneous vegetable matter amounts to 5 per cent, and was found in 30 stomachs. Of these, 11 contained fragments of flowers, probably of fruit trees, for in some cases the embryo fruit could be made out. This is not a very heavy indictment on the score of destroying buds and blossoms. Fibrous vegetable matter of uncertain origin was found in quite a number of stomachs; perhaps it was grass which had been subjected to the grinding action of the stomach.

SUMMARY.

Evidently neither the farmer nor the fruit grower has much to fear from the white-crowned sparrow. On the contrary the bird destroys some insects, all of which are harmful, and a vast number of seeds of noxious weeds. The little fruit it eats is mostly wild, and its grain eating is practically confined to the months when the only grain available is waste or volunteer. In the above record there is little to substantiate the accusation that the bird destroys fruit buds, and probably it is only under very exceptional circumstances that it does any damage in this way.

GOLDEN-CROWNED SPARROW.

(*Zonotrichia coronata.*)

The golden-crowned sparrow arrives in California from the north in September, and departs for its summer residence in April. In winter it spreads over the country, lives wherever food can be obtained, except perhaps in the forest, and may often be seen in the garden among the fruit trees or in the rose bushes. It is also found in lonely canyons or on the cattle ranges in the hills. In general appearance and in food habits it does not differ essentially from the white-crown. For the determination of its food 184 stomachs were available, taken from October to April, inclusive. The animal food amounts to 0.9 percent, vegetable to 99.1.

Animal food.—The animal food consists of insects, and is pretty well distributed among the various orders. No great quantity was found in any one stomach, and it is eaten so rarely and in such small quantities that the wonder is that it is eaten at all. Singularly enough two worker honeybees were found in one stomach. It is evident that the golden-crown does not search for insects, and takes only those that come in its way.

Vegetable food.—The vegetable food consists of fruit, buds and flowers, grain, and some miscellaneous matter. Fruit can not be a prominent item in the food of this sparrow, owing to the time of year it spends in California. One stomach taken in March contained a little fruit pulp, probably left over from the previous season. Fruit was found also in 2 stomachs taken in October and in 2 taken in November. In one it consisted of elderberries; in one, of grape; in another, it was thought to be apple; while in the fourth, it was unidentifiable. In all, it amounts to a little more than 1 percent of the food. Remains of buds and flowers were found in stomachs taken in every month of the bird's stay in the State, except October and November, when buds are very small. They were found in 56 stomachs; the average for the season is 29.5 percent, and in March it rises to nearly 78 percent. Where this bird is abundant, it may do mischief if it visits the orchards. In the stomach of no other species yet examined has been found so much of this kind of food, which makes it probable that much of the bud and flower eating imputed to the linnet and white-crown is really done by the golden-crown.

Grain was eaten during every month of the bird's stay in the State, but as none of these was a harvest month, little damage was done. March, the sowing month, showed but little more than 5 percent, while over 66 percent was eaten in January. The average for the season was nearly 26 percent. It was found in 23 stomachs, of which 12 contained oats; 6, wheat; 2, barley; 2, corn; and 1, doubtful.

Weed seed amounts to 33 percent of the food and is eaten in every month. It is, however, complementary to the bud and blossom food, the one increasing as the other decreases. Weed seed begins with a percentage of 83 in October, and gradually diminishes, while buds and blossoms appear first in December with 22 percent and increase to their maximum in April.

Below is a list of species identified, showing the number of stomachs in which each was contained:

Tarweed (*Madia sativa*)	11
Mayweed (*Anthemis cotula*)	15
Bur thistle (*Centaurea melitensis*)	18
Nightshade (*Solanum nigrum*)	16
Lupine (*Lupinus* sp.)	1
Clover (*Trifolium* sp.)	2
Turkey mullein (*Eremocarpus setigerus*)	2
Poison oak (*Rhus diversiloba*)	30
Alfilaria (*Erodium cicutarium*)	16
Geranium (*Geranium dissectum*)	16
Mustard (*Brassica nigra*)	1
Rough pigweed (*Amaranthus retroflexus*)	18
Spurry (*Spergula arvensis*)	4
Chickweed (*Stellaria media*)	10
Catchfly (*Silene* sp.)	1
Knotweed (*Polygonum* sp.)	10
Sorrel (*Rumex* sp.)	10
Brome grass (*Bromus* sp.)	11
Sedge (*Carex* sp.)	1
Seeds of conifer	1
Unidentified	39

The last item includes stomachs in which the food was ground to a pulp, rendering identification impossible. Few whole seeds were unidentified. Poison-oak seeds are indicated as found in 30 stomachs, but as a matter of fact not a single seed of that plant was seen in any stomach. The birds ate only the wax which surrounds those seeds and which contains certain woody granules by which it can at once be identified. This species, then, does not aid in the dissemination of these noxious plants.

SUMMARY.

From the foregoing it is evident that the golden-crown during its stay in California does but little service in destroying insects. On the other hand, it does no direct harm to fruit, and little, if any, to grain. It does good by destroying weed seed, although not as much as some other species. By the destruction of buds and blossoms it may do serious harm where it is numerous and visits the orchards.

WESTERN CHIPPING SPARROW.

(Spizella passerina arizonæ.)

The western chipping sparrow occurs during the breeding season and early fall over most of the State, and winters sparingly in the southern part. Like its eastern relative it is very domestic, and often builds its nests in gardens and orchards. The bird well merits the name *socialis*, now, unhappily, superseded, and its gentle and confiding ways endear it to all bird lovers. It is one of the most insectivorous of all the sparrows, and is valuable in the garden or about the farm.

For the investigation of this bird's food 96 stomachs were available. They were taken from April to October inclusive, and probably give a fair idea of the food for that part of the year. It is quite likely that the winter food consists largely, if not entirely, of weed seeds, as 4 stomachs taken in the southern part of the State in winter (not included in this investigation) were almost entirely filled with this food. The first division of the stomachs' contents gives 45 percent of animal food and 55 percent of vegetable.

Animal food.—The animal food consists of insects and spiders, with a few bits of eggshell. Beetles were eaten from April to August inclusive, with the maximum of 23 percent in July. In one stomach were the remains of 30 weevils or snout beetles, but so badly crushed and broken that specific identification was impossible. The average monthly percentage is 6.7. Hymenoptera amount to 11.8 percent. They are represented mostly by ants, with which several stomachs were entirely filled. The greatest quantity were eaten in June, when they aggregated 67.5 percent, or more than four-fifths of the animal food for the month. In the other months they were taken rather irregularly and in small quantities.

Hemiptera are eaten to the average extent of 7.5 percent. They appear rather irregularly, and the greatest consumption is in October, 20 percent. None were found in August or September stomachs, but as only 4 were collected in October, and not many in the two previous months, the record can not be considered as fully reliable. They consist of stinkbugs and leafhoppers, with a few others, of which the most interesting are scales and plant lice. These were each found in 5 stomachs. The scales were the black olive species (*Saissetia oleæ*). Diptera, or flies, do not appear to be favorite food with the chipping sparrow. They were eaten only in the months from April to July inclusive, with the maximum consumption in May, when about 12 percent were taken, or more than half of all. The average per month is only 3 percent.

Caterpillars are evidently the favorite animal food, as they were eaten to an average extent of 14.7 percent, or more than any other

insect. They appear in the food during every month of the bird's stay in the north except October, and probably a greater number of stomachs would have shown some in that month. Two stomachs contained pupæ of the codling moth. Only one stomach held grasshoppers, and that was taken in June. Some spiders and eggshells make up nearly 1 percent, and complete the animal food.

Vegetable food.—Grain in the shape of oats was found in 5 stomachs, all collected in July. The total amount for that month is 6 percent, or less than 1 percent for the season. A mere trace of fruit was found in one stomach in June. Weed seed was eaten in every month of the bird's stay, and probably throughout the year. It amounts to over 53 percent of the food, and in September rises to 98 percent. June was the month of least consumption, 9 percent, when insects evidently took its place. The species identified, and the number of stomachs in which each was found, are as follows:

Bur thistle (*Centaurea melitensis*)	2
Nightshade (*Solanum nigrum*)	1
Alfilaria (*Erodium cicutarium*)	37
Miner's lettuce (*Montia perfoliata*)	3
Red maids (*Calindrinia menzeisi*)	2
Rough pigweed (*Amaranthus retroflexus*)	16
Chickweed (*Stellaria media*)	13
Knotweed (*Polygonum* sp.)	1
Timothy (*Phleum pratense*)	1
Meadow grass (*Poa* sp.)	1
Panic grass (*Panicum sanguinale*)	2
Wild oats (*Avena fatua*)	1
Sedge (*Carex* sp.)	2
Unidentified	32

Most of the unidentified seeds were so badly ground up that it was impossible to recognize the species. The greater part probably belonged to species included in the above list. A few very small grass seeds were not further identified.

Feeding the young.—A nest with 4 young of this species, about 6 days old when first observed, was watched at different hours on four days. On the morning of the fifth day a pair of jays carried off the young birds. In the seven hours of observation 119 feedings were noted, or an average of 17 feedings per hour, or four and one-fourth feedings per hour to each nestling. This would give for a day of fourteen hours at least 238 insects destroyed by the brood.

SUMMARY.

In the foregoing discussion of the food of the chipping sparrow it plainly appears that the diet is made up almost exclusively of harmful elements. No useful beetles of any consequence were eaten. Of Hymenoptera, ants, which are either harmful or neutral, predominate,

while caterpillars, which are a universal pest, are the favorite animal food. In the vegetable portion of the diet fruit and grain appear as mere traces, while the seeds of noxious weeds make up the bulk of the food. It is not necessary to further eulogize this bird, as it is already welcomed everywhere, as it should be.

WESTERN SNOWBIRD.

(*Junco hyemalis thurberi* and other subspecies.)

Several subspecies of junco occur in California. One form, *J. pinosus,* is a resident of the Monterey Bay region the year round. Another, *thurberi,* is a resident of the State throughout the year, but winters in the valleys and breeds in the mountains. Two others, *oreganus* and *connectens,* occur in winter only, when all the forms spread out and cover a considerable part of the State. It would be better to treat the four races separately, but as many of the stomachs were collected before the races were recognized, their exact identity is unknown. They will be discussed, therefore, as a whole, but what is said of summer food will not apply to *oreganus* and *connectens.*

For this investigation 269 stomachs were available. They were collected in every month except May. March, April, June, and August are poorly represented, but the other months have each a good quota. The first analysis of the food gives 24 percent of animal matter to 76 of vegetable.

Animal food.—Beetles amount to 5 percent, and nearly all were eaten in the months from March to July inclusive, with no record for May. With the exception of two ladybirds (Coccinellidæ) found in 2 stomachs, not a useful species was identified in the whole. Weevils make up the bulk of this item, and a species of scolytid (*Phlœosinus punctatus*) was found in 1 stomach to the extent of 65 percent of its contents. Hymenoptera were represented mostly by ants, with a few wasps, amounting in all to a little more than 2 percent of the food. Caterpillars are apparently the favorite insect food, forming 9.4 percent of the diet. The great bulk were eaten from April to August, and the single stomach taken in August contained 67 percent of them. No special pest was identified. Bugs, grasshoppers, a few other insects, and spiders, make up the remainder of the animal food, 7.3 percent.

Vegetable food.—Seeds of blackberry or raspberry were found in 1 stomach and elderberries in 2. In 14 stomachs taken in November was found fruit pulp averaging over 11 percent of the food of the month. As all fruit except olives is harvested before that time, probably the berries were of no value.

Grain was eaten from October to March inclusive, and amounted to 8 percent for the year. All of it was contained in 30 stomachs, as

follows: Oats in 15, wheat in 9, barley in 4, corn in 1, and unidentified in 1. None was taken in a harvest month. The greatest amount, more than 30 percent, was eaten in March, the sowing month, probably much of it from newly sown fields.

Weed seed aggregates 61.8 percent of the food, and was eaten in every month. In September it amounted to nearly 95 percent. A few seeds, mostly of grass, were not identified. The following is a list of identified species and the number of stomachs in which each was contained:

Ragweed (*Ambrosia* sp.)	1
Tarweed (*Madia sativa*)	4
Mayweed (*Anthemis cotula*)	11
Bur thistle (*Centaurea melitensis*)	16
Sow thistle (*Sonchus asper*)	2
Nightshade (*Solanum nigrum*)	11
Lupine (*Lupinus* sp.)	1
Clover (*Trifolium* sp.)	1
Poison oak (*Rhus diversiloba*)	13
Alfilaria (*Erodium cicutarium*)	34
Geranium (*Geranium dissectum*)	4
Mustard (*Brassica nigra*)	3
Miner's lettuce (*Montia perfoliata*)	13
Red maids (*Calandrinia menziesi*)	2
Purslane (*Portulaca oleracea*)	1
Rough pigweed (*Amaranthus retroflexus*)	35
Spurry (*Spergula arvensis*)	9
Chickweed (*Stellaria media*)	42
Catchfly (*Silene* sp.)	21
Knotweed (*Polygonum* sp.)	33
Sorrel (*Rumex* sp.)	26
Wild oats (*Avena fatua*)	8
Timothy (*Phleum pratense*)	1
Panic grass (*Panicum* sp.)	3
Sedge (*Carex* sp.)	14
Coniferous seeds not identified	4
Unidentified	2

Remains of blossoms were found in 1 stomach. The seeds of poison oak were not discovered in the stomachs, but the characteristic granules that are embedded in the waxy coating of the seeds were identified, thus showing that the birds eat this wax without swallowing the seed itself.

SUMMARY.

The insect food of the snowbirds is composed almost entirely of harmful species, of which caterpillars form the largest item. Snowbirds do no damage to fruit or grain. They eat large quantities of weed seeds, thereby rendering a service to agriculture.

WESTERN SONG SPARROW.

(*Melospiza melodia samuelis, heermani*, and other subspecies.)

Song sparrows inhabit not only the greater part of California but all of the United States, except areas where conditions are unsuitable. These birds vary much in habits, as well as in size and coloration. Some forms live along streams bordered by deserts, others in swamps among bulrushes and tules, others in timbered regions, others on rocky barren hillsides, and still others in rich fertile valleys. Each area has its peculiar form, and in fact it is hard to imagine any locality adapted to a land bird of the Temperate Zone which does not fit some form of the song sparrow. With such a variety of habitat, the food of the species necessarily varies considerably. It is impossible to treat here the several forms separately, and the best we can do is to give a general idea of the yearly diet of the species as a whole.

For the investigation of the food of the western song sparrows, 321 stomachs, belonging to 4 or 5 subspecies, were available. They were collected in every month of the year, and fairly represent the whole State. The first analysis separates the food into 21 percent of animal matter and 79 of vegetable. This is less animal food than is eaten by the snowbird, much less than by the chipping sparrow, but much more than by the white-crowned or golden-crowned sparrows.

Animal food.—Animal food, consisting principally of insects, is eaten with a fair degree of regularity through the year. Beginning with a minimum of 3 percent in September, based on the examination of 97 stomachs, it rises gradually to a maximum of over 71 percent in May. Beetles are the largest item, and a greater or less number were eaten every month except December, an omission probably accidental. The average for the year is 6.6 percent. In June, the month of greatest consumption, nearly 29 percent were eaten. With the exception of the remains of tiger beetles (Cicindelidæ) in 3 stomachs and predaceous ground beetles (Carabidæ) in 10, all were of harmful families, the leaf beetles (Chrysomelidæ) and weevils (Rhynchophora) being most prominent.

Hymenoptera (bees, wasps, and ants) were taken very irregularly, and amount to only 3 percent of the food. Ants were found in 22 stomachs, and bees and wasps in 20. Hemiptera, or bugs, form only about 2 percent of the year's food, but 17 percent of the food eaten in May. The black olive scale was found in 2 stomachs and a species not identified in 1. Leafhoppers, spittle insects (Cercopidæ), and a few other forms make up the rest of this item. Diptera (flies) were eaten from May to September inclusive. In May they amount to over 11 per cent, but fall away rapidly, and the aggregate for the year is only 2 percent. A few crane flies (Tipulidæ) and the house fly family (Muscidæ) were the only forms recognized.

Caterpillars, while taken in nearly every month, were eaten very irregularly and to the extent of 4.3 percent only. There was a fair percentage from March to August inclusive, but in other months a trifle or none, except December, in which 5 percent were found. May shows the greatest amount, 14 percent. Grasshoppers are apparently not relished by the song sparrow. A mere trace of these insects was found in a few stomachs collected in February, May, June, and August. They do not form an appreciable percentage of the food. A few insects too finely pulverized for recognition, some spiders, and a few snails make up the remainder of the animal food, 2.5 percent.

Vegetable food.—Evidence of fruit eating was found in 19 stomachs as follows: Seeds of Rubus (blackberries or raspberries) in 9, elderberries in 4, cherries in 2, figs in 1, and fruit pulp or skins in 3. In all it amounts to a trifle more than 2 percent of the food. Grain was absent in all stomachs collected from February to June inclusive, and in November. What was eaten in the other months comes to a little more than 3 percent for the year. The most, 11 percent, was taken in January, but July shows very nearly the same. This last was perhaps gleaned from the field. The varieties are as follows: Barley found in 7 stomachs, oats in 5, and wheat in 2.

The chief food of the song sparrow is weed seed. This amounts to 73 percent of the year's food, and varies from one-fifth to very nearly the whole of each month's diet. In September, when animal food is at its minimum, weed seed reaches a little more than 93 percent. On the other hand, in May, when animal food is at its maximum, weed seed shrinks to a little less than 21 percent. Of the 321 stomachs, 302, or 94 percent, contained weed seed. Of these, 171, or 53 percent of all, were completely filled with it. There were only 19 stomachs that did not contain more or less of this food. The record of this sparrow for eating weed seed is excelled by only four species of California birds—the linnet, the two goldfinches, and the white-crowned sparrow.

Following are the species of weed seeds identified and the number of stomachs in which each was found:

Sunflower (*Helianthus* sp.)	1
Lesser tarweed (*Hemizonia fasciculata*)	1
Tarweed (*Madia sativa*)	9
Mayweed (*Anthemis cotula*)	7
Bur thistle (*Centaurea melitensis*)	36
Sow thistle (*Sonchus asper* and *oleraceus*)	5
Salsify (*Tragopogon porrifolius*)	1
Henbit (*Lamium amplexicaule*)	1
Nightshade (*Solanum nigrum*)	35
Nine bark (*Opulaster opulifolius*)	1
Turkey mullein (*Eremocarpus setigerus*)	1
Poison oak (*Rhus diversiloba*)	3
Alfilaria (*Erodium cicutarium*)	23

Geranium (*Geranium carolinianum*)	1
Mustard (*Brassica nigra*)	1
Miner's lettuce (*Montia perfoliata*)	26
Red maids (*Calandrinia menziesi*)	6
Pigweed (*Chenopodium album*)	1
Rough pigweed (*Amaranthus retroflexus*)	113
Spurry (*Spergula arvensis*)	12
Chickweed (*Stellaria media*)	32
Catchfly (*Silene* sp.)	3
Knotweed (*Polygonum* sp.)	44
Sorrel (*Rumex* sp.)	16
Brome grass (*Bromus* sp.)	4
Wild oats (*Avena fatua*)	14
Timothy (*Phleum pratense*)	1
Canary seed (*Phalaris caroliniana*)	2
Fox tail (*Chaetochloa* sp.)	1
Panic grass (*Panicum sanguinale*)	4
Sedge (*Carex* sp.)	8
Unidentified	97

As usual, the unidentified were either ground to pulp or were seeds of some unknown grass. Evidently the rough pigweed seed (*Amaranthus*) is the favorite. Several stomachs contained nothing else.

SUMMARY.

The economic status of the song sparrow can be summarized in a few words. It eats a comparatively small number of insects, the majority of which are noxious. Fruit and grain are eaten so little as to be of no consequence. Nearly three-fourths of the diet consists of seeds of weeds, most of which are a nuisance. Neither stomach examinations nor field observations furnish evidence that the song sparrow does any harm.

SPOTTED TOWHEE.

(*Pipilo maculatus* and subspecies.)

Under one or other of its several subspecific forms the spotted towhee occurs almost throughout California. As it is resident over much of its range, the good or harm it does continues through the year. It is eminently a bird of the ground and underbrush, and delights in the thickest shrubbery, where it scratches among the dead leaves and twigs. Anyone who approaches the bushes too closely will probably see the bird depart from the opposite side and plunge into another thicket, and in this way one may chase it for hours with no more than an occasional glimpse. This bird is not common about orchard or garden, the chaparral-covered hillsides and canyons being more congenial resorts. It is abundant and widely distributed, and hence is comparatively important from an economic point of view.

For the investigation of the food of this bird 139 stomachs were at hand, collected in every month of the year, though November to May inclusive were not represented as fully as was desirable. The

first analysis of the food gives 24 percent of animal matter to 76 of vegetable. Dead leaves, bits of twigs, rotten wood, and other rubbish are very common in the stomachs, and probably are swallowed accidentally with more nutritious morsels.

Animal food.—Beetles are the largest item of animal food, and amount to a little more than 10 percent. Although the larger part of the towhee's living is gleaned from the ground, only 4 stomachs contained the remains of predaceous ground beetles, and 2 others the remains of ladybirds (Coccinellidæ). Weevils were found in 26 stomachs, and in 13 stomachs were the remains of that harmful chrysomalid beetle *Diabrotica soror*. Besides these were fragments of elaterids, buprestids, and cerambycids, all of which in the larval state bore into trees and other plants and do great mischief. Hymenoptera amount to 6 percent of the diet, but are eaten rather irregularly. They are mostly taken in summer, but some appear at all times of the year. They were found in 39 stomachs, of which 25 contained ants, and 14, wasps and bees.

Bugs (Hemiptera) amount to 14 percent, and are distributed among several families; but the only point that merits mention is that the black olive scale was found in 4 stomachs and an unidentified scale in 1. The spotted towhee does not appear to care for grasshoppers. They form only 1.7 percent of the year's food, and are eaten very irregularly. In June they reach a little more than 11 percent, in August they amount to only 6 percent, and few were found in other months. Caterpillars aggregate 3.5 percent of the food. They are eaten rather irregularly, without much regard to season, but the greatest number, 12 percent, were taken in April. A few flies, some other insects, spiders, millepeds, and sowbugs (*Oniscus*) make up about 3 percent, the remainder of the animal food. These last are just what the bird would be expected to get by scratching among underbrush.

Vegetable food.—Fruit was eaten in every month from May to November inclusive, with a good percentage in each month. January also shows 11.7 percent, but this was either wild or waste. The average for the year is 17.7 percent. The month of greatest consumption was November, when it amounted to 53.6 percent. All of it was in the shape of fruit pulp, not further identifiable. At that time of year it could have been of no value. Fruit pulp, identified only as such, was found in 23 stomachs. Rubus seeds and pulp (raspberries or blackberries) were found in 23 stomachs; cherries, grapes, and figs in 1 each. Elderberries (*Sambucus glauca*) were found in 6 stomachs, snowberries (*Symphoricarpos racemosus*) in 3, and black twinberries (*Lonicera involucrata*) in 1. The fruit eaten in June and July was almost entirely Rubus fruit, which may have been either wild or cultivated, except in one case, where the seeds of Logan

berries were identified. In August and September the fruit eaten was of the larger varieties, like apricots, peaches, and prunes. Later in the year the wild kinds only were taken. The one stomach which contained cherries was collected the last of May. If this bird were as abundant as the linnet, it would do considerable damage to the larger fruits. Under present conditions its depredations probably pass unnoticed.

Grain was eaten from June to December, inclusive, except in November. The amount for the year is 4.7 percent. In August, the month of greatest consumption, 16 percent was taken. It was found in 17 stomachs, of which 10 contained oats; 3, wheat; 3, corn; and 1, barley. As most of this was gleaned after harvest, probably no harm was done.

Weed seed is a standard article of diet with this bird, as with many others. It was found in 93 of the 139 stomachs, and 11 contained nothing else. The average amount for the year is 34.6 percent of the food, and it was found in every month except March; but as only one bird was collected in that month, the exception is probably accidental. January was the month when most was eaten, 62.8 percent, but as some other months stood nearly as high, this has no special significance. Bur thistle seems to be the favorite seed, although the towhee does not show so strong a preference for any weed as some other species exhibit.

Following is a list of species identified and the number of stomachs in which each was found:

Tarweed (*Madia sativa*)	10
Bur thistle (*Centaurea melitensis*)	27
Nightshade (*Solanum nigrum*)	8
Plantain (*Plantago lanceolata*)	1
Senna (*Cassia* sp.)	1
Clover (*Trifolium* sp.)	1
Legumes unidentified	3
Turkey mullein (*Eremocarpos setigerus*)	2
Poison oak (*Rhus diversiloba*)	11
Sumac (*Rhus* sp.)	1
Alfilaria (*Erodium cicutarium*)	11
Mustard (*Brassica nigra*)	1
Miners' lettuce (*Montia perfoliata*)	8
Red maids (*Calandrinia menziesi*)	2
Rough pigweed (*Amaranthus retroflexus*)	11
Chickweed (*Stellaria media*)	8
Knotweed (*Polygonum* sp.)	4
Sorrel (*Rumex* sp.)	5
Wild oats (*Avena fatua*)	9
Sedge (*Carex* sp.)	3
Unidentified	34

Another article of the towhee's food is mast. It is somewhat difficult to distinguish between mast and weed seed when both are ground to a pulp. As divided, however, mast amounts to 15.6 percent of the

food. It was found in moderate quantities in stomachs collected from September to February inclusive, and in April also it reached 25 percent, with a trace in June. February was the month in which most was eaten, 46.5 percent. It was found in only 22 stomachs, but 8 of them were completely filled with it. Leaf galls and some unidentified vegetable matter make up a little more than 3 percent, and complete the vegetable food.

SUMMARY.

The spotted towhee is not numerous enough to inflict any great damage, whatever its food habits. Should it become very abundant it might do harm to fruit; but it is so shy that the more the country is cleared and settled the more rare is it likely to become.

CALIFORNIA TOWHEE.

(*Pipilo crissalis* and *senicula*.)

In rural communities on the Pacific coast, the California towhee occupies a place similar to that of the robin in the east. It is quite domestic in habits, and not only is it a familiar sight about orchards and gardens, but it often builds its nest in the shrubbery and vines around the house. Its habits are somewhat more terrestrial than those of the robin, and the fruit it eats is largely that which it finds on the ground. Like the spotted towhee, it forages much under bushes and vines, scratching among the rubbish for food; however, it does not confine itself to such places, but frequents also the open ground, looking for insects and seeds. At such times a pair are almost invariably seen together. The species does not migrate. One or other of its subspecies inhabits most of the valley and foothill country of California west of the Sierra Nevada and San Jacinto mountains.

For the study of the bird's food 399 stomachs were available, collected in every month, with a fair number in each month. The first analysis gives 14.26 percent of animal food to 85.74 of vegetable. The animal food consists of insects and a few spiders, millepeds, and snails. The vegetable part is made up of fruit, grain, weed seeds; and a few miscellaneous substances.

Animal food.—The largest item of the animal food consists of beetles, which amount to 5 percent. The predaceous ground beetles (Carabidæ) were found in 30 stomachs, and were the only useful beetles eaten. Weevils, or snout beetles, were found in 55 stomachs, of which 1 contained 15. Among them was identified one specimen of *Calandra oryza*, the rice weevil, an insect that does much harm to rice. A decidedly harmful species of chrysomelid beetle (*Diabrotica soror*) was found in 43 stomachs. All the other beetles, which belong to several families, are harmful. While beetles were eaten in every month except December, the great bulk were taken from April

to July, inclusive. In June they amount to nearly 15 percent, which is the highest for any month.

Hymenoptera amount to less than 2 percent. They consist of ants found in 47 stomachs and bees or wasps in 23 stomachs. Hemiptera, or bugs, are eaten to a small extent in nearly every month, but do not reach a high percentage in any. The maximum, 6 percent, occurs in March. The average is barely 1 percent for the year. The favorite kinds appear to be leafhoppers, shield bugs, and stinkbugs. Black olive scales were found in 11 stomachs, and a second species, not identified, in 1.

Caterpillars are eaten sparingly in every month. The amount for the year is 3.26 percent, and the maximum consumption, 8.5 percent, occurs in March. Pupæ of the codling moth were found in 2 stomachs. Grasshoppers and crickets amount to 2.5 percent for the year. In July they aggregate nearly 16 percent, which is a remarkably small amount for such a confirmed ground feeder as the towhee. They are eaten rather irregularly from April to October inclusive, with a trace in January. The remainder of the animal food, consisting of a few flies and other insects, spiders, millipeds, and snails, amounts to a little more than one-half of 1 percent.

The following insects were identified in the stomachs:

COLEOPTERA.

Bradycellus rupestris.
Philonthus albionicus.
Tachyporus californicus.
Hypnoides ornatus.
Ptilinus ruficornis.
Aphodius rugifrons.
Aphodius rubidus.
Diabrotica soror.
Blapstinus pulverulentus.
Blapstinus rufipes.
Notoxus alamedæ.
Calandra oryza.

HEMIPTERA.

Saissetia oleæ.

LEPIDOPTERA.

Carpocapsa pomonella.

Vegetable food.—Fruit was eaten in every month from April to October inclusive, and also in December and January. The total for the year is 4.4 percent of the food. The greatest quantity was taken in June, when it amounted to 9.3 percent. Fruit, consisting of pulp and skins without seeds, was contained in 24 stomachs, Rubus fruits (blackberries or raspberries) in 28, cherries in 4, strawberries in 3, and elderberries in 41. Thus the towhee does no great damage to fruit—in fact, the fruit eaten is mostly wild or that which has been injured and left on the ground.

Grain is eaten regularly in every month and in a fair quantity. It amounts for the year to about 28 percent. The most is taken in fall and winter, though the variation is not very marked. August appears to be the month of greatest consumption, but it is doubtful if this would hold true if more stomachs were examined, as October

is about the same. June shows a higher percentage than either May or July, which indicates that some of the grain was gathered from the harvest field. Oats were the favorite kind, found in 140 stomachs. Barley was contained in 34, wheat in 16, and corn in 6. Sixteen stomachs were filled with grain alone, most of them with oats, but several with barley and one with corn.

The towhee is another of those species whose standard food is weed seed. It amounts to nearly 51 percent of the yearly diet. Even in June, the month of least consumption, it amounts to one-fifth of the food, while in December it reaches its maximum, 83.6 percent; but a good percentage is eaten in every month, no matter what other food is at hand.

Weed seed was found in 304 stomachs, and 46 contained nothing else. The quantity of this seed consumed by the towhees of California in one year must be enormous. The following are the species identified and the number of stomachs in which each was found:

Sunflower (*Helianthus* sp.)	1
Lesser tarweed (*Hemizonia fasciculata*)	7
Tarweed (*Madia sativa*)	34
Mayweed (*Anthemis cotula*)	6
Milk thistle (*Silybum marianum*)	1
Bur thistle (*Centaurea melitensis*)	39
Burweed (*Amsinckia tesselata*)	4
Nightshade (*Solanum nigrum*)	22
Plantain (*Plantago lanceolata*)	1
Lupine (*Lupinus* sp.)	19
Clover (*Trifolium* sp.)	9
Legumes not further identified	39
Turkey mullein (*Eremocarpos setigerus*)	5
Poison oak (*Rhus diversiloba*)	7
Alfilaria (*Erodium cicutarium*)	55
Geranium (*Geranium dissectum*)	1
Yellow sorrel (*Oxalis corniculata*)	4
Mustard (*Brassica nigra*)	10
Poppy (*Eschscholtzia californica*)	2
Miners' lettuce (*Montia perfoliata*)	26
Red maids (*Calandrinia menziesi*)	4
Pigweed (*Chenopodium album*)	1
Rough pigweed (*Amaranthus retroflexus*)	77
Spurry (*Spergula arvensis*)	2
Chickweed (*Stellaria media*)	27
Catchfly (*Silene* sp.)	5
Knotweed (*Polygonum* sp.)	40
Sorrel (*Rumex acetosella*)	10
Brome grass (*Bromus* sp.)	5
Wild oats (*Avena fatua*)	33
Canary seed (*Phalaris canariensis*)	1
Panic grass (*Panicum* sp.)	1
Unidentified	77

Mast, in the shape of acorn meat, was taken to a slight extent. It reaches about one-half of 1 percent for the year. Vegetable rubbish aggregates 2.4 percent.

Food of young.—Among the 399 stomachs already discussed were those of 16 nestlings. They consisted of one brood of 3 about 2 days old; 3 broods, 9 in all, about 10 days old; and one brood of 4, probably 2 weeks old. The three youngest ones had been fed entirely on animal food, mostly grasshoppers, caterpillars, and spiders, with a few bugs. The 9 next in age had been fed animal matter to an average extent of 92 percent, to 8 percent of vegetable food. The animal food differs in proportions, not in constituents, from that taken by the adults. It is composed mainly of grasshoppers and caterpillars, with a few beetles, bugs, and wasps. The vegetable matter contains a little fruit, but the greater part is made up of wads or tangles of vegetable fibers. In one stomach the tangle consisted of horsehair. The same fact has been noted with the young of other species. The four that were 2 weeks old had been fed 95 percent of animal food and 5 percent of vegetable matter. The animal part is not so largely composed of grasshoppers, caterpillars, and spiders as with the younger birds, but beetles, wasps, and ants are more prominent. All of them contained remains of the beetle *Diabrotica soror* to an average extent of nearly 33 percent. Every one of these 4 stomachs contained a tangle of vegetable fibers, which constituted the whole of the vegetable food except one seed.

Some observations were made upon the feeding of nestlings of this species. It was found that the young are not fed as often as those of some other species, but probably get more at each feeding. The parent visiting the nest to feed the young gives food to all of them before leaving, and evidently regurgitates it from the gullet for this purpose. As the result of watching two nests for several hours, the maximum number of feedings in one hour was found to be 6, but from 2 to 4 was nearer the average. During the intervals between the feedings the parents could be seen hopping about on the ground and in the shrubbery searching for food, with which they appeared to gorge themselves, for caterpillars and other insects could be seen projecting from their bills. Both parents took part in the feeding, though when the nestlings were very young one bird stayed near or upon the nest until the other came, when they exchanged work.

SUMMARY.

The little animal food the California towhee eats is mostly of an injurious character. While eminently a ground feeder, it does not eat more of the predaceous ground beetles (Carabidæ) than other birds less terrestrial in their habits, and no more than a due proportion. In its vegetable food it probably does little, if any, damage. The amount of fruit eaten is small, and is mostly either damaged or wild. While it eats considerable grain, the great bulk is taken in the fall and winter months. Probably it does not visit the harvest fields much, for although a ground frequenter, it likes the presence of trees

and bushes. The service it performs in destroying the seeds of weeds should be sufficient to cover a number of sins, but fortunately there are none serious enough for consideration.

BLACK-HEADED GROSBEAK.

(*Zamelodia melanocephala.*)

During the six months from April to September inclusive, the black-headed grosbeak occurs throughout the State of California, excepting the arid deserts and boreal mountain summits. Like its eastern relative, the rose-breasted grosbeak, it takes readily to orchards and gardens, and is common in agricultural districts. It is a bird of beautiful plumage and sweet song, and is a welcome addition to the attractions of rural life. It often nests in orchard trees, and, as is perfectly natural, gets much of its food there. While this consists mainly of harmful insects, a goodly part of it is fruit. The grosbeak, as its name indicates, has a very powerful bill, and has no difficulty in cutting the skin of the firmest fruit. It feeds upon cherries, apricots, and similar fruits to a considerable extent, but on the other hand it habitually consumes some of the worst insect pests, such as the black olive scale, the 12-spotted diabrotica, and the codling moth. The destruction of this trio alone should entitle the bird to great consideration, but it eats also other destructive insects.

For the laboratory investigation of this bird's food 225 stomachs were accessible. They were collected in the six months from April to September inclusive, a fair number in each, except the last, when only 3 were obtained. These stomachs contained about 57 percent of animal matter to 43 of vegetable. The animal matter is composed of insects and spiders, with a few traces of vertebrates. Insects, such as beetles, scales, and caterpillars, constituted nearly 53 of the 57 percent of animal food.

Animal food.—Of the animal food, beetles are the largest item. They were found in 190 of the 225 stomachs. Of these, predatory ground beetles (Carabidæ) were found in 16 stomachs, and ladybird beetles (Coccinellidæ) in 2. To offset the destruction of these useful insects, the 12-spotted diabrotica, which often does serious injury to fruit trees, was found in 109 stomachs. Many weevils were found, and great numbers of several species of leaf beetles (Chrysomelidæ). To this family belongs the notorious Colorado potato beetle, which at one time seemed likely to ruin the potato industry of the East. The bird which attacked this pest constantly and systematically was the rose-breasted grosbeak, a near relative of the one under consideration. When the potato beetle finds its way into California, as eventually it undoubtedly will, the black-headed grosbeak is the bird most likely to become its active enemy.

Hymenoptera in the form of bees and wasps with a few ants aggregate less than 2 percent. A worker honeybee was found in one

stomach. Scale insects amount to 19.83 percent, or practically one-fifth of the whole food. Most of these were the black olive scale (*Saissetia oleæ*), but a few were the plum and prune scales (*Lecanium corni* and *L. pruinosum*). So persistently are scales eaten by this bird that they were found in 142 of the 225 stomachs, or 63 percent of all. While they did not entirely fill any stomach, in 26 they equaled or exceeded 50 percent of the contents. Hemiptera other than scales amount to a trifle over 1 percent.

Caterpillars, pupæ, and a few moths aggregate 7.7 percent. They were mostly eaten in April and May. Pupæ or larvæ of the codling moth were found in 26 stomachs, one stomach containing the remains of 29. Flies, grasshoppers, a few other insects, spiders, and miscellaneous creatures make up somewhat more than 1 percent. Eggshells were found in several stomachs and the bones of a small fish in one. The animal food of the grosbeak, it will be observed, is nearly all included in the 3 items, beetles, scales, and caterpillars. The other substances appear to be eaten merely as makeshifts.

Following are the insects identified in the stomachs of the grosbeak:

COLEOPTERA.

Platynus variolatus.
Rhizobius ventralis.
Psyllobora taedata.
Megapenthes elegans.
Buprestis fasciata.
Podabrus sp.
Telephorus consors.
Telephorus divisus.
Telephorus sp.
Aphodius rugifrons.
Aphodius sp.
Leptura militaris.
Syneta albida.
Gastroidea cyanea.
Gastroidea sp.
Lina scripta.
Diabrotica soror.
Diabrotica trivittata.
Blapstinus sp.
Deporaus glastinus.
Scythropus californicus.
Dorytomus hispidulus.
Baris sp.
Balaninus sp.

HEMIPTERA.

Saissetia oleæ.
Lecanium pruinosum.
Lecanium corni.

LEPIDOPTERA.

Carpocapsa pomonella.

HYMENOPTERA.

Apis mellifera. ♀

DIPTERA.

Borborus sp.

Vegetable food.—Cultivated fruit amounts to 23 percent of the grosbeak's food for the six months that it stays in the North. None was found in the stomachs taken in April, but in all other months there was a good percentage. Cherries appear to be the favorite fruit, as they were contained in 42 stomachs. Figs were identified in 24 stomachs, blackberries or raspberries in 23, strawberries in 2,

apricots in 1, and prunes in 1. Fruit pulp, not further identified, but probably of the larger kinds, was found in 25 stomachs. During cherry season these birds were almost constantly in the trees eating cherries. They do not appear to attack apricots, peaches, and prunes so extensively, but they feed freely on figs later in the season. Blackberries and raspberries are taken whenever possible, but mostly in July and August, after cherries are gone. There is no denying the fact that the grosbeak eats much fruit, and of the best kinds. Wild fruit amounts to something over 5 percent. All of it was eaten in the four months from May to August inclusive, but principally in July and August. The only wild fruit identified was the elderberry (*Sambucus*), which constitutes the bulk of this item, and was found in 26 stomachs.

Seeds of various weeds and some grain constitute 14.7 percent of the food. Oats were found in 9 stomachs and wheat in 7, but the amount was insignificant. The rest of the vegetable food consists of the seeds of more or less troublesome weeds, of which the grosbeak eats a very considerable quantity. The following is a list of the species identified and the number of stomachs in which each was found:

Milk thistle (*Silybum marianum*)	5
Nightshade (*Solanum nigrum*)	1
Bur clover (*Medicago lanceolata*)	2
Poison oak (*Rhus diversiloba*)	1
Sumac (*Rhus sp.*)	1
Alfilaria (*Erodium cicutarium*)	12
Geranium (*Geranium dissectum*)	13
Dwarf mallow (*Malva rotundifolia*)	1
Red maids (*Calandrinia menziesi*)	6
Rough pigweed (*Amaranthus retroflexus*)	3
Chickweed (*Stellaria media*)	13
Knotweed (*Polygonum sp.*)	2
Sorrel (*Rumex acetosella*)	1
Unidentified	24

Food of young.—Among these stomachs are those of 17 nestlings, varying in age from 2 to 8 days. The youngest brood, composed of 3, had been fed entirely on beetles, Hymenoptera, and caterpillars. For convenience, codling moth pupæ may be separated from other caterpillars. The average percentage of each was as follows: Beetles 0.7, Hymenoptera 0.7, caterpillars 92.3, codling moth pupæ 6.3. Note the large percentage of soft food in the shape of caterpillars and pupæ. Broods 2 and 3 were composed of 3 and 4 nestlings respectively, and were probably about 1 day older than brood 1. Their stomachs were entirely filled with animal food, divided as follows: Beetles 15 percent, caterpillars 55.4 percent, codling moth pupæ 23 percent, scales 2.6 percent, and other insects and spiders 4 percent. These nestlings had been fed with hard beetles to a much

greater extent than brood 1, although only 1 day older. Brood 4 was composed of 4 nestlings about a week old. They had been fed on animal matter to the extent of 96 percent to 4 percent of vegetable. The animal food was divided as follows: Beetles 67.6 percent, Hymenoptera 3 percent, caterpillars 2 percent, scales 20.7 percent, and eggshells 2.7 percent. The vegetable matter consisted of hulls of seeds and rubbish. The increase in beetles and other hard food and the decrease in caterpillars in the diet of this brood, as compared with the younger ones, is very marked. Brood 5 contained 3 young, estimated to be 8 days old. These had been fed entirely on animal food, made up of the following elements: Beetles 82 percent, Hymenoptera 10 percent, scales 6.3 percent, larvæ 3.3 percent, insects' eggs 1.7 percent, and spiders 2.7 percent. Another increase in the hard elements of the food over the last is seen here, although the difference in age is presumed to be only a day.

Observations were made upon the feeding of nestling grosbeaks, but the results are not remarkable. A nest of 3 young, estimated to be about 3 days old when first seen, was watched for one-hour periods for several days. The number of feedings varied from 2 to 4 per hour. In this respect the grosbeaks much resemble the California towhee. Like that bird they evidently collect a lot of food and then supply all the nestlings by regurgitation.

SUMMARY.

In summing up the economic status of the black-headed grosbeak, the fact that it eats a considerable quantity of orchard fruit can not be ignored. That this fruit is taken from the ripening crop on the tree is also true. This, however, is the sum total of the grosbeak's sinning. It eats but few useful insects and practically no grain. To offset its fruit eating, it eats habitually and freely the black olive scale, the codling moth, and the 12-spotted diabrotica, three pests of California fruit culture. Comparatively few complaints have been made against this bird by orchardists, and its depredations are not believed to be serious. Should it ever become so plentiful as to cause serious loss, no attempts should be made to destroy the bird, but attention should be directed to devices for protecting the fruit, thus leaving the bird to continue its good work in the destruction of insects. So active an enemy of insect pests as is this grosbeak can not well be spared, especially in view of the possibility of an invasion of the State by the Colorado potato beetle.[a]

[a] For further information on the food of the grosbeak, see Bull. 32, Biological Survey, Food Habits of Grosbeaks, by W. L. McAtee, 1908.

O

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 755 OCTOBER 26, 1916

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.

COMMON BIRDS OF SOUTHEASTERN UNITED STATES IN RELATION TO AGRICULTURE.

By F. E. L. BEAL, W. L. MCATEE, and E. R. KALMBACH,
Assistant Biologists.

CONTENTS.

INTRODUCTION.

By W. L. MCATEE.

In the Southeastern States, as restricted for the purposes of this bulletin (fig. 1), there occur at some season of the year more than 460 species of birds. Of these, about 280 are common, and the number includes some of the handsomest birds of the United States, as the scissor-tailed flycatcher, the painted bunting, and the cardinal; besides some of the most pleasing songsters, as the last-named species, the mockingbird, the brown thrasher, and the Carolina wren. The general habits, and particularly the economic value, of 23 of the best-known species are treated in the following pages.[1]

The food habits of southeastern birds are of particular interest on account of the prevalence in this section of the country of a number of the worst insect enemies of agriculture, many of which are eagerly

[1] For a list of department publications relating to the food of certain other birds inhabiting this same area, see last page of this bulletin.

NOTE.—The food habits and relation to agriculture of 23 species of birds common in the Southeastern States are described; of general interest but especially applicable to the section covered.

50402°—Bull. 755—16——1

sought by birds. One need only recall such pests as the cotton boll weevil, the bollworm, and the chinch bug to realize with what serious foes the farmer of the Southeastern States has to contend. It is hoped that knowledge of the part birds play in combating his enemies will lead the southern farmer to take an active interest in securing full protection for these, his feathered allies.

Cotton being the leading crop in the Southeast, the bird enemies of cotton insect pests naturally deserve first consideration. Few in all this broad land are ignorant of the tremendous damage done by the cotton boll weevil. For some years it has easily ranked as the most destructive pest in the United States. Special study of its bird enemies has been made, and the result is that 66 species are now known which, to a greater or less extent, prey upon the boll weevil. A list of these, which constitutes a roll of honor among southeastern birds, is here given:

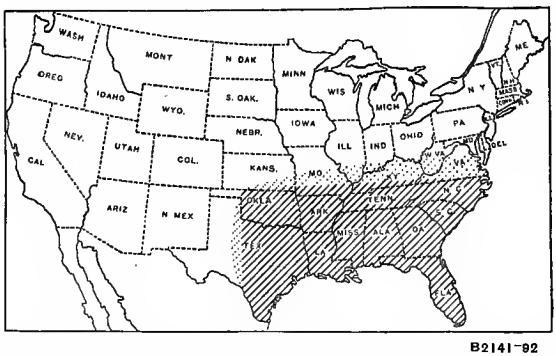


FIG. 1.—Map of the United States, the shaded area showing the territory to which this bulletin applies.

BIRD ENEMIES OF THE COTTON BOLL WEEVIL.

Upland plover.	Bullock oriole.	Cliff swallow.
Killdeer.	Rusty blackbird.	Barn swallow.
Bob-white.	Brewer blackbird.	Tree swallow.
Red-headed woodpecker.	Bronzed grackle.	Bank swallow.
Flicker.	Boat-tailed grackle.	Rough-winged swallow.
Nighthawk.	English sparrow.	Loggerhead shrike.
Chimney swift.	Vesper sparrow.	White-eyed vireo.
Scissor-tailed flycatcher.	Savannah sparrow.	Yellow warbler.
Kingbird.	Lark sparrow.	Myrtle warbler.
Crested flycatcher.	White-throated sparrow.	Pine warbler.
Phœbe.	Field sparrow.	Maryland yellow-throat.
Olive-sided flycatcher.	Chipping sparrow.	Yellow-breasted chat.
Wood pewee.	Swamp sparrow.	American pipit.
Alder flycatcher.	Fox sparrow.	Mockingbird.
Least flycatcher.	Towhee.	Brown thrasher.
Blue jay.	Cardinal.	Carolina wren.
Cowbird.	Gray grosbeak.	Bewick wren.
Red-winged blackbird.	Blue grosbeak.	Winter wren.
Meadowlark.	Painted bunting.	Tufted titmouse.
Western meadowlark.	Indigo bunting.	Black-crested titmouse.
Orchard oriole.	Dickcissel.	Carolina chickadee.
Baltimore oriole.	Purple martin.	Bluebird.

The most active of these enemies of the boll weevil are the orioles, which actually take the insects from the squares of the cotton plant, and the swallows, which feed upon the weevils when they are in flight and seeking to extend their range. No fewer than 41 boll weevils have been found in a single stomach of the Bullock oriole, and large numbers of the weevils are habitually taken by all species of swallows. Every one of a series of 35 eave swallows had eaten boll weevils, the largest number in any stomach being 48, and the average 19. In winter the most important destroyers of these insects are blackbirds, meadowlarks, titlarks, and Carolina wrens.

Forty-one species [1] of birds feed upon the cotton worm. Of these bird enemies, cuckoos are most effective, since they frequently consume from 100 to 150 cotton worms at a meal. The orioles again deserve especial mention, as do also the crow, the curve-billed thrasher, mockingbird, cardinal, and gray grosbeak. The bollworm, or corn-ear worm, is attacked by 12 southeastern birds, of which the boat-tailed grackle, or jackdaw, has the best record. Seven species of birds feed upon the cotton cutworm.

If insect pests are considered in the order of the importance of the crops they attack, those damaging corn and other grain crops probably are next to the cotton insects. White grubs are a serious pest not only to corn but to strawberries, various garden crops, and grasses. Fifty-seven species of southeastern birds devour white grubs or the adult forms known as May beetles. The nighthawk, chuck-will's-widow, crow, and screech owl are the most voracious feeders on the adults, and the crow, crow blackbird, and robin on the larvæ. Remains of no fewer than 91 adults have been found in a single stomach of the nighthawk, or bull-bat, a bird which has been much persecuted but which deserves the strictest protection.

Wireworms are especially injurious to corn, but they damage all other grains, as well as many garden crops. These pests are the larvæ of click beetles, of which there are many species. One hundred and twenty-eight southeastern birds include click beetles or wireworms in their bill of fare. The most efficient destroyers of these pests are the following: Downy and red-bellied woodpeckers, nighthawk, kingbird, great-crested flycatcher, crow, blue jay, crow blackbird, red-winged blackbird, lark sparrow, tree swallow, purple martin, house wren, and robin. From 20 to 40 wireworms have been found in each of several robin stomachs.

Corn is seriously damaged by billbugs also. The larvæ bore into the stem and the adult weevils injure the leaves. Fifty-five species of birds occurring in the Southeastern States feed upon these insects. Those consuming the largest numbers are the killdeer, upland plover,

[1] This and similar figures in the remainder of the introduction must be understood as representing only present knowledge—other species may at any time be added to the lists of bird enemies of the various insect pests.

nighthawk, crow, red-headed woodpecker, and the yellow-headed and crow blackbirds. Forty-three kinds of birds feed upon the army worms, pests destructive to corn and all small grains. Eighty-eight southeastern species devour cutworms, which are often the despair of grain growers and gardeners. Largest numbers of cutworms have been found in stomachs of the prairie chicken, bob-white, wood duck, woodcock, sparrow hawk, yellow-billed cuckoo, nighthawk, red-headed woodpecker, crow blackbird, meadowlark, English sparrow, cardinal, and robin.

No insect enemy of corn and wheat is more destructive than the chinch bug; when it is numerous, fields are blasted as if by fire. It is often said that the chinch bug has few natural enemies, but the work of birds, 24 species of which feed upon chinch bugs, should not be overlooked. Over 100 of these pests have been found in single stomachs of the bob-white and meadowlark, and over 200 in one of a brown thrasher. Other birds consuming chinch bugs in considerable numbers are the flicker, the crow, the barn, tree, and cliff swallows, and the house wren. The southern corn leaf beetle, a pest that has come to be of considerable importance in the past few years, is devoured by 22 kinds of birds. Those taking the largest numbers are the mockingbird, the Bewick wren, and the house wren.

Among other corn insects may be mentioned the southern corn rootworm (or spotted cucumber beetle), eaten by 26 species of southeastern birds; beetles of a group including the cane root borer and the carrot beetle, devoured by 18 species; and the brown fruit-chafer, by 21. The last-named beetle feeds also on apples, pears, and peaches, as does a related insect known as the southern fig eater. Fourteen species of birds prey upon the fig eater, the crow most extensively.

The insect pests of clover and other forage crops in the Southeastern States also are sought by many birds. Perhaps more damage is done in the aggregate by leafhoppers than by other enemies of these crops. Exactly 100 species of southeastern birds are now known to feed on these small but exceedingly numerous insect pests. Largest numbers of leafhoppers have been found in stomachs of the nighthawk, chimney swift, barn swallow, and yellow-headed blackbird. Clover is attacked by a number of insect pests, including the imbricated-snout beetle and the various clover weevils. The first named is eaten by 20 kinds of birds, of which the crow, crow blackbird, and catbird seem most voracious. The common or large clover leaf weevil is the prey of 25 species of birds. The nighthawk, crow, red-headed woodpecker, purple martin, and crow blackbird have the best records for destruction of adults, and the Savannah and vesper sparrows of the larvæ. The smaller clover weevils are eaten by 74 species of southeastern birds. Largest numbers of these weevils

have been found in the stomachs of the robin, hermit thrush, tufted titmouse, and white-crowned sparrow, and of the following four species of birds, some representative of each of which had consumed at one meal more than 50 individuals: Nighthawk, chimney swift, tree swallow, and purple martin.

It is perhaps worth while to mention the bird predators upon certain insect enemies of truck crops. The destructive little cucumber flea beetle and its congeners, which feed on potato, tomato, sweet potato, eggplant, and tobacco, are preyed upon by 19 species of southeastern birds. The sweet potato flea beetle and its allies have 28 known bird enemies in this section; the grapevine leaf beetle, 21; the grape flea beetle, 23; and the bean leaf beetle, 19. The rice weevil has been found in stomachs of 20 species of birds, the notorious Colorado potato beetle in 26, and the periodical cicada, or 17-year locust, in 33. Pests of considerable importance in the South whose bird enemies it is well to mention are the horseflies. These are preyed upon by 49 species of southeastern birds. The stomach of one killdeer contained 40 horsefly larvæ.

The foregoing demonstrates that many of the worst pests of southern agriculture have enemies in the bird world. The insects which have been considered chiefly are those destructive to grain and field crops; but among forest insects, fruit insects, and all the host that prey upon truck and garden crops, few can be mentioned that do not have important bird enemies. Farmers should recognize their friends and do all in their power to protect them.

HOUSE WREN.[1]

The house wren (fig. 2), a fussy, flighty, and fidgety little midget, frequents the vicinity of barns and gardens and particularly old orchards where the trees are partially decayed. Never for a moment at rest while there is a ray of daylight, it would seem that his small body must soon be worn out by his incessant activity. His voice, as tireless as his wings, is heard from morning until night about the garden and orchard where he seeks his daily food, and while not very melodious it is cheerful and suggestive of life and activity.

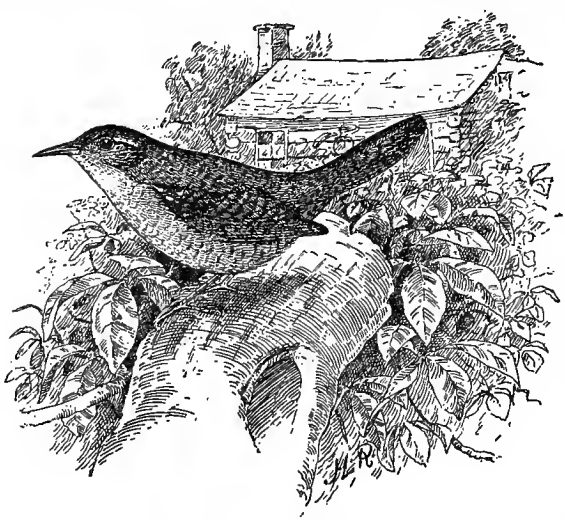
Probably no bird displays greater eccentricity in the selection of a nesting site than the house wren. A hollow branch or a knothole in a post or stump are his more prosaic choices. When more esthetically inclined he affects old boots or hats hung up to scare the robin from the cherries, or takes an old copper pot or tomato can lying on the roof of a back shed; or, if the gardener hangs his coat on the fence when warm weather begins and forgets it for a few days, he may find when he returns that an enterprising wren has preempted one of the pockets and has his domestic affairs under full headway. The empty skull of a horse or cow when set on a post by the frolicsome schoolboy makes an excellent nesting place for the wren, who is never troubled by the ghost of the former occupant. Whatever place he chooses, his ambition is to occupy the whole of it. This he accomplishes by carrying in sticks, straws, and other rubbish until all available space is filled, only just room enough being left for the mother bird and her eggs.

[1] *Troglodytes aëdon.*

Curious as may be the nesting habits of this little creature, his chief interest to the farmer and gardener centers about his tastes in the matter of food. He aspires to a large family; six to a brood is his favorite number, and this he likes to duplicate once or twice in the course of the summer; of course so many mouths to be filled require great activity on the part of the head of the family, but the wren is fully equal to the task and his brood never suffers from hunger. He is an industrious forager, searching every tree, shrub, and vine for caterpillars and examining every post and rail of the fence and every cranny in the wall for insects and spiders.

The wren is found all over the United States east of the Great Plains in summer and it winters in the Southern States.

For the purpose of this paper the food of 68 birds was examined and found to consist entirely of animal matter (mostly insects). The largest four items, taken in the order of their size, are bugs, grasshoppers and their allies, caterpillars, and beetles. Beetles collectively constitute 13.81 per cent of the food. Of these, the predacious ground beetles and a number of "ladybugs" (3.03 per cent) are practically the only useful insects eaten by the wren. Snout beetles, or weevils (4.93 per cent), are eaten in every month of the wren's stay in the South. Other beetles (5.85 per cent) are largely of the leaf-beetle family, to which belong some of the greatest pests in the insect world.



B2142-87

FIG. 2.—House wren. Length, about 5 inches.

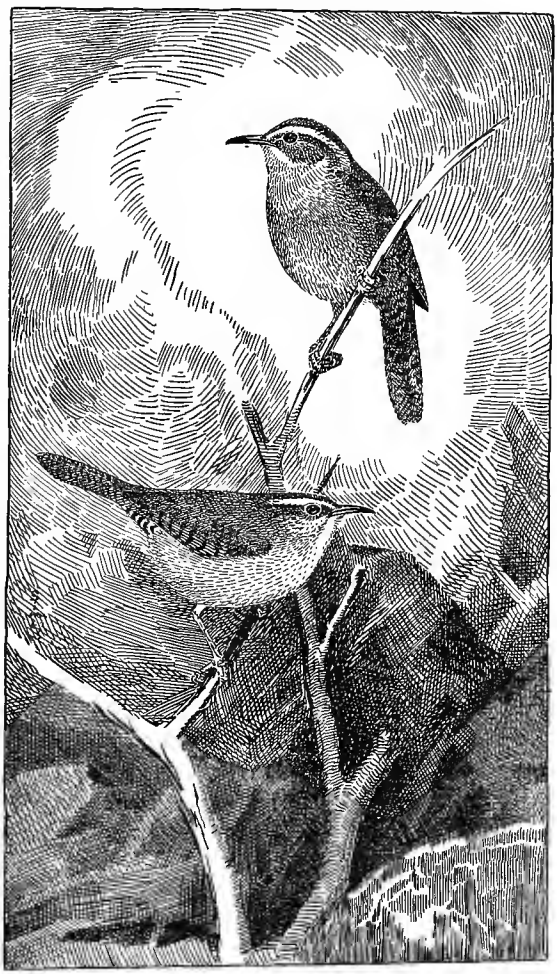
Moths and caterpillars reach very nearly the same percentage as beetles. The former are eaten to the extent of 13.9 per cent, but many are adult insects instead of caterpillars. The wren seems to have a decided taste for these fuzzy creatures.

Grasshoppers and their kin—crickets, locusts, etc.—were represented in the food of every month in goodly numbers, the aggregate being 17.61 per cent. The greatest consumption occurred in January (31.2 per cent) and November (31 per cent); the smallest, a mere trifle, in April. The largest item in the food is made up of bugs (29.34 per cent), chiefly stinkbugs, a few negro bugs, and some leafhoppers; but a good many more are those slim-bodied, long-legged, slow-moving creatures that may be found straddling over the herbage about pools or wet places and over bushes. The thread-legged bugs and marsh treaders are examples. As these creatures have no great economic significance, so far as known, the wren does neither good nor harm in eating them. The stinkbugs, negro bugs, and tree-hoppers and leafhoppers are harmful insects, and in eating them and feeding them to its young the wren is an aid to the agriculturist.

Ants are eaten to the extent of 8.2 per cent of the yearly food, and in March constitute 22.67 per cent. Bees and wasps amount to 3.27 per cent. Flies, a mere trifle in the food of the wren, are evidently left to the more fleet flycatchers and swallows.

Spiders are acceptable and are captured every month in the season. The wren finds these when searching under piles of lumber or brush, stone walls, hollow logs, outhouses, and sheds. They aggregate 10.51 per cent of the food, and in March 32.5 per cent. Millepeds (thousand-legs) form a part (2.76 per cent) of the food of the first four months of the year, six-sevenths of them being eaten in April. Other creatures, as sowbugs and snails, were found in a few stomachs, but are a negligible quantity.

No accusation has been brought against the wren that it harms fruit or other farm products. Both field observation and stomach examination show that it consumes great numbers of noxious insects, thereby benefiting the farmer and gardener. It is a cheery, bustling little creature to have about the homestead and should be thoroughly protected. Put up a box where cats can not get at it and the wren will pay good rent.—F. E. L. B.



B2143-67

FIG. 3.—Carolina wren. Length, about 5½ inches.

CAROLINA WREN.[1]

The Carolina wren (fig. 3) is resident from the Gulf of Mexico north to the southern boundaries of Iowa, Illinois, and Connecticut in the breeding season, but in winter withdraws somewhat farther south. It is a bird of the thicket and undergrowth, preferring to place its nest in holes and crannies but when necessary will build a bulky structure in a tangle of twigs and vines. Unlike the house wren it does not ordinarily use the structures of man for nesting sites. It is one of the few American birds that sing throughout the year. Most birds sing, or try to, in the mating season, but the Carolina wren may be heard pouring forth his melody of song every month. The writer's first introduction to this bird was in the month of January when he heard gushing from a thicket a song which reminded him of June instead of midwinter.

This wren keeps up the reputation of the family as an insect eater, as over nine-tenths of its diet consists of insects and their allies. In this investigation of its food

1 *Thryothorus ludovicianus.*

there were examined 291 stomachs, representing every month. Their contents were made up of 94.18 per cent animal matter, nearly all insects, and 5.82 per cent vegetable, chiefly seeds. A very marked uniformity in the diet is noticeable, the winter season showing almost as great a consumption of insects as the summer.

Of the animal food, beetles amount to 13.64 per cent, all injurious except a few useful predatory ground beetles (1.71 per cent); two-fifths of these were eaten in December, presumably on account of scarcity of other insects. Many species of snout beetles, or weevils, were identified (4.29 per cent), but the most interesting economically is the cotton boll weevil, 31 individuals of which were found in 18 stomachs. Other beetles, like the 12-spotted cucumber beetle, the striped cucumber beetle, the bean leaf beetle, and numerous so-called flea beetles, all more or less harmful, occur in many stomachs and form 7.64 per cent of the total food.

Ants (4.63 per cent) were found in the stomachs collected every month except September and in very uniform quantities. The greatest consumption was in July (8.81 per cent). For each of the 11 months bees and wasps amount to about the same as the ants. Bugs, with one exception, are the most important item in the diet of the Carolina wren (18.91 per cent), and were eaten every month, with a good percentage for each. The maximum (32.16 per cent) was taken in February. The majority of the insects eaten were of the larger species, as stinkbugs, or soldier bugs, leaf-legged bugs, and leafhoppers. Four stomachs contained the chinch bug and in one there were 5 individuals. Scale insects destructive to oranges were found in one stomach.

Caterpillars and a few moths, the largest item in the food (21.73 per cent), were eaten every month with a good percentage for each. The month of greatest consumption is September, when they constitute more than one-third of the whole food (39 per cent). No special pest was observed, but as the Carolina wren is a small bird the caterpillars are usually so torn to pieces that the species can not be determined; and the moths eaten were so fragile as to be unidentifiable after the process of digestion had begun.

Grasshoppers and crickets, with a few other orthopterous insects, as cockroaches and their eggs, constitute 12.57 per cent of food of the Carolina wren and form a fairly large percentage of the food from July to the end of the year. The average consumption for these months is 19.65 per cent, while that for the first six months is only 5.49 per cent. As with many other birds the month of greatest consumption is August (26.9 per cent).

Flies do not appear very acceptable as food to the wren. None were eaten in January, August, or September, and comparatively few in the other months. The average for the year is a trifle over 3 per cent. The sort mostly taken are the so-called "daddy longlegs," or crane flies.

Spiders are apparently very attractive to wrens in general, particularly to the Carolina wren, which probably finds them when investigating crannies of buildings, piles of lumber, or heaps of brush, as is its habit when looking for nesting sites, or when not pressed by other responsibilities. This wren eats spiders in every month, and in the five months from April to August to the extent of 16.67 per cent for each. In the remaining seven months spiders aggregate 6.16 per cent of the food, an unusual percentage; the average for the year is 10.54 per cent. Most wrens eat spiders more than do other birds, but the Carolina wren excels them all. Millepeds, or thousand-legs, are eaten sparingly throughout the year (2.06 per cent) and none were taken in January, June, or September.

Animals other than insects, as sowbugs and snails, were found in a few stomachs, but constitute only 0.16 per cent. Vertebrate animals would hardly be expected to form part of the diet of so small a bird, but the Carolina wren eats them often. Remains of lizards were found in 14 stomachs, tree frogs in 8, and a snake in 1; totaling 1.92 per cent.

The great bulk of the vegetable food of the Carolina wren consists of various kinds of seeds, mostly of trees or shrubs. Of these, bayberry was found in 20 stomachs,

sweet gum in 10, poison ivy in 7, sumac in 4, pine in 2, smart weed and other weeds in 7, and mast (ground up acorn) in 2. Besides these a few stomachs contained pulp which could only be identified as "fruit."

From this analysis of the food of the Carolina wren, it is evident that the farmer and fruit grower have not the slightest cause for complaint against the bird. It eats neither cultivated fruit nor grain, and does not even nest in an orchard tree; but it does feed on numerous injurious insects and enlivens the tangled thickets with its cheerful song for 12 months in the year.—F. E. L. B.

MOCKINGBIRD.[1]

The mockingbird (fig. 4) has always been held in such high esteem for its vocal powers that any attempt to add to its reputation by showing that its food habits also are in its favor may seem superfluous. The title of the mockingbird to rank among economic benefactors has not heretofore been quite clear, however, for, though it does considerable good in the destruction of harmful insects, it is said to eat much fruit, and where fruit raising is an important industry, as in the Southern States, particularly Texas and Florida, bitter complaints are made against it. In Florida, the bird is charged with attacking grapes and oranges, and in Texas it is asserted that figs must be added to the list of fruit it damages.

B2144-66

FIG. 4.—Mockingbird. Length, about 10½ inches.

For the present investigation of the mockingbird's food 417 stomachs were available, and these disclosed 47.81 per cent animal matter to 52.19 per cent vegetable. This is more than twice the proportion of animal food observed in mockingbirds from California. Perhaps the abundant fruit in that section proves too great an attraction for the birds to bother with insects. The stomachs of southeastern birds examined were very evenly distributed over every month. Most of the animal food is taken in May (85.44 per cent). Vegetable food attains its maximum in December and January (86.55 per cent each).

[1] *Mimus polyglottos.*

The important items in the animal diet are beetles, ants, bees, wasps, grasshoppers, caterpillars, and a few each of several other groups. Useful beetles, mostly predacious ground beetles (3.47 per cent), together with grasshoppers, show that the mockingbird must gather a considerable portion of its food upon the ground. Harmful beetles (7.38 per cent) are of sorts mostly found on leaves of trees, bushes, or plants which are the natural habitat of the mocker. Many of these were weevils, and among them were nine specimens of the cotton boll weevil, in six stomachs. About a dozen stomachs contained remains of the 12-spotted cucumber beetle. Many other species were identified which are nearly as harmful but not so well known.

Ants (4.46 per cent), found in 75 stomachs, again show that the mockingbird goes to the ground for at least a portion of his food. Bees and wasps (3 per cent) are mostly good flyers and must either be taken on the wing or picked from flowers, and it is in the latter situation probably that the mockingbird gets them.

True bugs are eaten so seldom by this bird that the item would not be worth mentioning were it not that one stomach contained remains of that notorious wheat and corn pest, the chinch bug. This insect has probably caused more loss to agriculture than any other in the United States. Although the percentage in the food of the mockingbird is insignificant, any bird that eats this pest deserves honorable mention.

Flies are apparently merely tasted and pronounced not good, for a trace of them is all that stomachs show. Grasshoppers, on the contrary, appear to be the favorite animal food. They are eaten every month and average 14.85 per cent for the year. In July they rise to 43.33 per cent, but in February there is only a mere trace. All the other months make a reasonable showing. Insects of this group captured include true grasshoppers, locusts, and crickets, all harmful and some very much so, as, for instance, the Rocky Mountain locust or grasshopper, which devastated the upper Mississippi Valley a few decades ago.

Caterpillars (9.48 per cent) were found every month in the diet of the mockingbird with a reasonable percentage in all except October. The most were taken in August (23.89 per cent), though nearly as many were eaten in May. Among a host of others, all more or less harmful, was the cotton leaf worm, found in 23 stomachs, and the cotton bollworm, in 2 stomachs. This latter is not confined to the South, but preys upon corn, tomatoes, and other crops all through the central and northern portions of the country. A few insects other than those already discussed were found, but the percentage is insignificant. Spiders were eaten sparingly (less than 2 per cent) in every month except October. A few millepeds, crawfish, sowbugs, and snails also were eaten, but the most singular food consisted of three lizards and a small snake, found in four stomachs.

The predominant vegetable food of the mockingbird is wild fruit. This is eaten every month and totals 42.58 per cent for the year, or more than four-fifths of the vegetable portion. The maximum consumption (76.91 per cent), occurs in October. Wild fruit was found in 246 stomachs, and 76 contained nothing else. Thirty-five species of fruit were identified, and it is probable that more were present but too far digested to be recognized. Those most frequently eaten were the different species of holly, smilax, woodbine, blackberry, pokeberry, elderberry, mulberry, and sour gum.

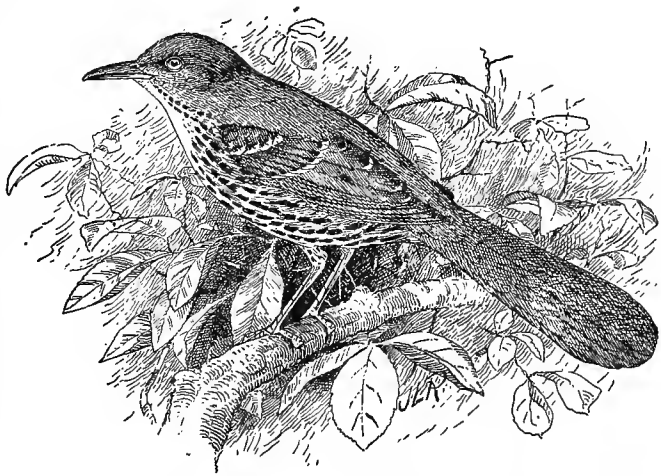
Domestic fruit (3.35 per cent), the great bulk of which was either raspberries or blackberries, was found in stomachs collected from May to August. Both of these berries grow wild in great abundance over most of the country and those eaten by the mockingbird are as apt to be taken from thickets and briar patches as from gardens. None of the larger fruits were certainly determined, but figs were found occasionally. A few grapes were identified, but these may as well have been wild as domestic. The mockingbird will probably do little harm to cultivated fruits so long as wild varieties are accessible and abundant. The remaining vegetable food was of no great importance, being made up of various weed seeds, sumac seeds of several species—including the poisonous (found in four stomachs)—petals of flowers, and rubbish. No grain of any kind was found.

There appears to be nothing to prove that the mockingbird eats domestic fruits to an injurious extent. It has in general enjoyed about the same place in the affections of the southern people that is held by the robin in the North, and judging by the results of this investigation it well deserves the place.—F. E. L. B.

BROWN THRASHER.[1]

Few birds excel the brown thrasher in sweetness of song, but it is so shy that its notes are not heard often enough to be appreciated. Its favorite time for singing is in early morning, when, perched on the top of some tall bush or low tree, it gives an exhibition of vocal powers which would do credit to a mockingbird. Indeed where the latter bird is abundant, the thrasher is sometimes known as the sandy mocker.

The brown thrasher (fig. 5) breeds throughout the United States east of the Great Plains, and winters in the South Atlantic and Gulf States. It occasionally visits the garden or orchard, but nests in swamps or in groves standing upon low ground, and sometimes builds in a pile of brush at a distance from trees. On account of its more retiring habits it is not so conspicuous as the robin, though it may be equally abundant.



B2146–66

FIG. 5.—Brown thrasher. Length, about 11½ inches.

The food of the thrasher consists of both fruit and insects. An examination of 266 stomachs showed 37.38 per cent vegetable and 62.62 per cent animal food, the latter practically all insects.

The most noticeable peculiarity in the food is that no one item is greatly in excess of others, while in the case of the yellow-billed cuckoo, for instance, caterpillars constitute more than half the food. With the thrasher the largest item is made up of beetles (18.14 per cent). A few of these (4.82 per cent) are of useful species, mostly predacious ground beetles. Others (13.32 per cent) are of a more or less harmful character, the great bulk being May beetles and weevils, or snout beetles. Among the latter is the notorious cotton boll weevil, found in six stomachs. May beetles, when in the grub stage, injure roots of grass and other plants. The 12-spotted cucumber beetle, another destructive pest, also was found in many stomachs. Beetles are eaten regularly throughout the year, although a little more from March to June than in other months.

Ants form a surprisingly small percentage of the yearly food (1.38 per cent) when the fact is considered that the thrasher gets most of its food upon the ground, where most ants live. The small destruction of bees and wasps (0.93 per cent) is not surprising, as the thrasher is hardly agile enough on the wing to catch such swift fliers. These three insects, however, are very evenly distributed throughout the year, each month showing a small percentage. Bugs, mostly stinkbugs with a few negro bugs, make up

[1] *Toxostoma rufum.*

1.54 per cent and are very regularly distributed. One bird taken in Illinois had eaten chinch bugs, but none were found in stomachs from farther south. Flies (1.76 per cent) are evidently not a favorite food of the thrasher, and nearly all of those eaten were taken in November. One stomach secured that month in a Mississippi cotton field was filled with flies except 6 per cent of fruit of "French mulberries"; the bird had probably found a colony of flies hibernating in a crevice and had devoured the whole lot.

Caterpillars (5.95 per cent) stand next to beetles in the thrasher's food, and are taken every month except November; that month, however, is represented by only five stomachs. Grasshoppers and crickets would seem to be very available to the thrasher, as the insects live on the ground, where also the birds get their food; but, unlike the meadowlark, these birds do not esteem grasshopper diet enough to go out in the sunshine to seek it. This food (2.43 per cent for the year) is taken to some extent every month, the maximum (8.5 per cent) in September.

A few insects of other groups are picked up occasionally. In all they amount to only one-fourth of 1 per cent. Spiders (0.58 per cent) are eaten now and then, and myriapods (thousand-legs) to a somewhat greater extent (2.24 per cent), but very irregularly, the maximum (8 per cent) in January. A few miscellaneous animals, like crawfish, sowbugs, snails, and angle worms, make up 1.26 per cent. Bones of lizards, salamanders, and tree frogs (in all, 0.92 per cent) were found in 11 stomachs.

Of the insects eaten by the brown thrasher there is only one class to which exception can be taken—the predacious beetles. That these insects render some service to man is beyond reasonable doubt, though some of them also do injury. Their destruction, then, is not an unmixed harm, but in any case the more numerous noxious insects eaten by the thrasher more than compensate for the useful beetles incidentally destroyed.

The vegetable food of this bird is nearly equally divided between fruit and a number of other substances, of which mast is the most prominent. Wild fruit, the largest item in the vegetable portion (19.94 per cent), was eaten every month in varying quantities, the month of maximum consumption (45.69 per cent) being September; January and February, with dried-up fruit from the last summer's crop, stand next. Altogether about 30 species of wild fruits or berries were identified in the stomachs. Those most eaten are blueberries, huckleberries, holly berries, elderberries, pokeberries, hackberries, Virginia creeper, and sour gum. Some seeds not properly classified as "fruit" were found, as bayberry, sumac—including some of the poisonous species—pine, and sweet gum.

Domestic fruit, or what was called such, was found in nine months, from April to the end of the year, most of it (53.19 per cent) in July. Raspberries or blackberries, currants, grapes, cherries, and strawberries were positively identified by their seeds, but as all of these grow wild, it is probable that much that is conventionally termed domestic fruit is really from uncultivated plants. The aggregate for the year is 12.42 per cent. Most unexpected in the thrasher's diet was mast, principally acorns, although some of it was so finely ground up that it was not possible to tell its exact nature. It is also somewhat a matter of doubt as to just where to draw a dividing line between mast and seeds, so that the proportion of each is somewhat uncertain. In the case in hand the total for the year is estimated at 23.72 per cent. Mast was eaten every month except August, but mostly in fall and winter—November, the month when acorns are abundant and fresh, showing the greatest quantity (57.4 per cent).

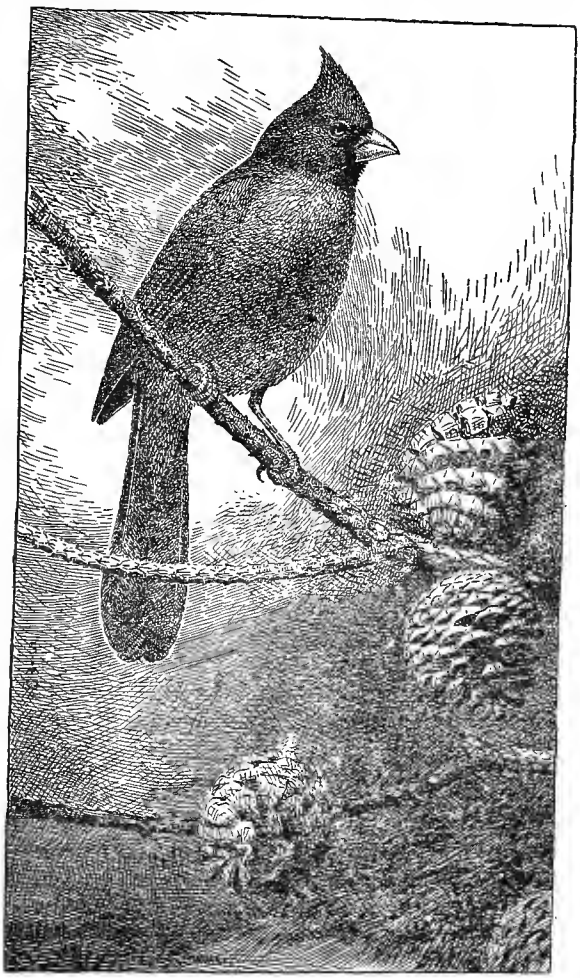
Grain (2.57 per cent) was found in the stomachs for six months, but in only February, March, and May were there noteworthy percentages. March shows 12.37 per cent, the other two slightly less. The grain was nearly all corn, with a little wheat, but from the season in which it was taken most of it evidently was waste.

The farmer has nothing to fear from depredations on fruit or grain by the brown thrasher. The bird is a resident of groves and swamps rather than of orchards and

gardens, so that it comes but little into contact with the products of husbandry, and does not prey upon them extensively when it does. The useful insects that it eats are amply paid for by its destruction of noxious ones.—F. E. L. B.

CARDINAL.[1]

Vivacity, beauty, and vocal expertness are three outstanding traits of the cardinal, or redbird (fig. 6). Whether the eye is held by the vivid color that suggested the bird's name, or by the active, graceful movements, the raising and lowering of the crest, which when fully erect gives the bird an appearance of such keen attention, or whether the ear is charmed by the rich and varied song, the impression produced is one of extreme pleasure.



B2146-56

FIG. 6.—Cardinal. Length, about 8¼ inches.

Though somewhat shy, the cardinal does not entirely avoid the vicinity of homes. However, it prefers more secluded resorts. Shrubbery is its chosen haunt, the more tangled the better. Here the nest is built and the young reared, and here they spend most of their days. Higher trees are usually sought only under the inspiration of song.

Viewed from the economic standpoint the cardinal deserves favorable comment, as it does for its other high qualities. Its food is composed of about 29 per cent animal matter and 71 per cent vegetable. Among the insects eaten are a few that are beneficial, but at most not more than 2 per cent of the cardinal's food, probably less, consists of useful insects, while twelve times as much is made up of injurious species. Caterpillars are greatly relished, and among those discovered in the food were three pests of the cotton crop, namely, the cotton worm, the bollworm, and the cotton cutworm. Ninety-six of the last-named species were eaten by 31 cardinals from Texas cotton fields. Other caterpillar pests eaten are the purslane sphinx, zebra caterpillar, and codling moth.

[1] *Cardinalis cardinalis.*

Grasshoppers, together with true bugs, form more than one-tenth of the total food. These groups of insects comprise many injurious forms of which the cardinal takes due toll. Especially commendable is the destruction of scale insects, of which several different species were identified from the stomachs of 21 redbirds.

Beetles comprise more than a tenth of the whole diet. Among them, weevils are predominant. The acorn weevils, clover weevils, and billbugs, all injurious forms, are freely eaten, and the cotton boll weevil occasionally. Vine chafers of various species, the southern fig eater, and rose chafers are among other injurious beetles destroyed. Click beetles, cucumber beetles, strawberry root borers, plum and locust leaf beetles also are devoured by the cardinal. The bird has a record for feeding on many of the worst agricultural pests.

The vegetable food consists chiefly of weed seeds, but wild fruit and grain also are eaten to some extent. The grain, however, is largely waste, as it is taken only in winter. Wild fruit, or rather the seeds of wild fruit which usually are extracted and the pulp rejected by the redbird, composes about one-fourth of the total subsistence. Wild grape seeds are favorites, but those of dogwoods, blackberries, hackberries, smilax, cherries, blueberries, elderberries, pokeberries, and juneberries, and the fruit of prickly pear, sumac, holly, redhaw, passion flower, Mexican mulberry, and palmettos also are eaten. Little, if any, attention is paid to cultivated fruits.

Most important among the items of vegetable food is weed seed. This forms more than a third of the total food. Seeds of smartweeds and bindweeds rank first in preference, and the seeds of the following troublesome weeds are freely eaten: Foxtail, bur, cockspur, crab and yard grasses, dodder, dock, sow thistle, plantain, tumbleweed, nail grass, lamb's-quarters, chickweed, sticktight, partridge pea, and buttonweed. The redbird occupies an important place among birds devouring weed seeds.—W. L. M.

GRAY GROSBEAK.[1]

The gray grosbeak, or parrot-bill, is about the same size as the cardinal, closely resembles that bird in song and general demeanor, and has similar nesting habits. Moreover, it frequents the same kind of country and is resident wherever found. In appearance, however, it is quite dissimilar.

In strong contrast to the glowing hue of the cardinal the general color of both sexes of the parrot-bill is light gray. The wings, tail, and long crest are suffused with dark red and the wings are lined with rose. This color also surrounds the beak of the male and extends over throat and breast in an irregular patch. The beak is yellowish and is very curiously modified, being short, thick, strongly curved, and apparently of great power.

The gray grosbeak comes into the lower half of Texas, not reaching, however, the extreme eastern part of the State.

Seventy-four stomachs of gray grosbeaks from Texas have been examined, 59 collected in August and 15 in September. Vegetable matter averages 71.19 per cent of the contents and animal matter 28.81 per cent.

Grass seeds constitute an average of 53.09 per cent of the total food of the birds examined, or more than five-sevenths of the vegetable food alone. Most important among them are foxtail and bur grass, which together amount to 43.59 per cent of the food. Since these grasses are among the most pernicious of weeds, the parrot-bill is more than welcome to all their seeds it desires.

The seeds of other grasses eaten are important, furnishing 9.51 per cent of the bird's subsistence. Among these are witch and crab grasses, most species of which are weeds, and yard or wire grass. Seeds of a spurge contribute 9.81 per cent of this grosbeak's fare, and other weeds, including bindweed, lamb's-quarters, tumbleweed, sunflower, carpetweed, nightshade, vervain, and mallow compose 6.13 per cent.

[1] *Pyrrhuloxia sinuata texana.*

While the parrot-bill consumes a smaller proportion of animal matter than the cardinal, it selects about the same things, the principal items being grasshoppers, caterpillars, and beetles. Neither parasitic hymenopterans nor predacious beetles were found in the stomachs examined, a showing much to the bird's credit. Only one useful insect had been eaten, it belonging to a queer neuropteroid genus, the members which are rare. They are predacious when adult, and when young are parasitic in the egg sacs of spiders.

The remaining animal food is composed of injurious species, many of them important pests. Beetles constitute 4.66 per cent of the food, weevils alone being 3.42. Of greatest interest among the latter is the cotton boll weevil, the most serious agricultural pest of recent years. While the gray grosbeak does not feed upon it regularly, nevertheless the habit of picking it up when occasion offers is highly commendable. Leaf beetles, bronzy wood borers, and long-horned beetles, all of which are destructive to forest and orchard trees, also were found in stomachs of this species

Beetles, as a whole, are exceeded in the food of this bird by caterpillars, the latter constituting 10.32 per cent of the diet. One of the species identified—the cotton worm—has long been known as a great pest throughout the Southern States, and in certain years has caused a decrease in the crop of a quarter of a million bales, valued at $25,000,000. Fourteen of the 74 gray grosbeaks examined consumed cotton worms, which averaged 39.1 per cent of their food. As many as 18 caterpillars were found in a single stomach. Another caterpillar enemy of the same crop—the cotton cutworm—also is freely devoured.

As beetles are less esteemed than caterpillars by the gray grosbeak, so also are the latter less liked than orthopterous insects. This group contributes 11.52 per cent of the total food, and includes both long and short-horned locusts and their eggs, 7 or 8 grasshoppers sometimes being secured by a single bird. True bugs, comprising stinkbugs and their eggs, cicadas, leafhoppers, and lantern flies come to about 1.5 per cent. All these insects are injurious and the bird does a service by feeding upon them.

One parrot-bill was bold enough to swallow a large hornet. A few ants also were eaten, and these, together with spiders and snails, complete the list of animal food taken. Although this grosbeak is not conspicuously insectivorous, almost all the insects it eats are injurious.

The data at hand are insufficient to determine finally the exact economic status of the bird, but it may be stated with confidence that the gray grosbeak is almost entirely beneficial.—W. L. M.

PAINTED BUNTING.[1]

The male painted bunting (fig. 7) is one of the most brilliantly colored birds of the United States. The upper part of the head and neck are shining purplish violet, the middle of the back yellowish green, wings and tail purplish blue, and underparts and rump vermilion. The female is dark green above and yellowish beneath.

This little jewel has not failed to attract popular attention and in consequence has received a variety of common names. In Louisiana the French speaking people have called it nonpareil (unequaled), and le pape (the pope). The last name has been contracted to pop and varied as red pop. Spanish speaking citizens know the bird as mariposa (butterfly), and in English the bird has variously been named painted bunting or finch, paradise finch, Mexican canary, and Texas canary.

The painted bunting is not only distinguished in appearance, but also is one of the most pleasing songsters among the finches. It is a persistent vocalist, and this characteristic, in addition to its beauty and activity, makes it a most desirable species for the vicinity of homes. Fortunately the bird is not averse to proximity to man,

[1] *Passcrina ciris.*

and its preference for shrubbery further adapts it to living about dooryards and gardens. The nest, though usually placed low, is well concealed, and the eggs number three to five.

Few complaints have been lodged against the painted bunting on the score of its food habits. It is said to eat rice at times, to peck into figs and grapes, and to bite off the tips of pecan shoots. In no case that has come to notice, however, has it been charged with doing serious damage. Certainly no such charge is supported by the investigations of the Biological Survey, for no product of husbandry has thus far been found in any of the stomachs, 80 of which have been examined, all collected in Texas in July, August, and September. Averages for the July and August material only are here presented. Animal matter composed 20.86 per cent of the contents of these stomachs, and vegetable matter 79.14 per cent. Of the former, 2.48 per cent was made up of weevils, mostly cotton boll weevils. All insects of this group are destructive, but none more so than the notorious cotton boll weevil, and this species had been eaten by 18 of the 80 nonpareils examined.

B2147-56

FIG. 7.—Painted bunting. Length, about 5¼ inches.

Another enemy of the cotton crop attacked by these brightly colored little birds is the cotton worm. This insect was preyed upon to the extent of 3.14 per cent of the total food of the 80 painted buntings examined. Other insects eaten include grasshoppers, crickets, click beetles, leaf beetles, caterpillars, true bugs, and small hymenopterans. A few spiders and one snail also were taken.

The vegetable food is remarkable in consisting very largely of a single item—the seeds of foxtail or pigeon grass. This is one of the worst weeds in the United States. The 80 painted buntings made over two-thirds (precisely 67.03 per cent) of their total food of its seeds. The seeds of other grasses composed 5.88 per cent of the food, grasses alone thus furnishing over nine-tenths of the vegetable portion. The other vegetable matter eaten consists largely of seeds of such weeds as amaranth, mallow, sorrel, and nail grass.

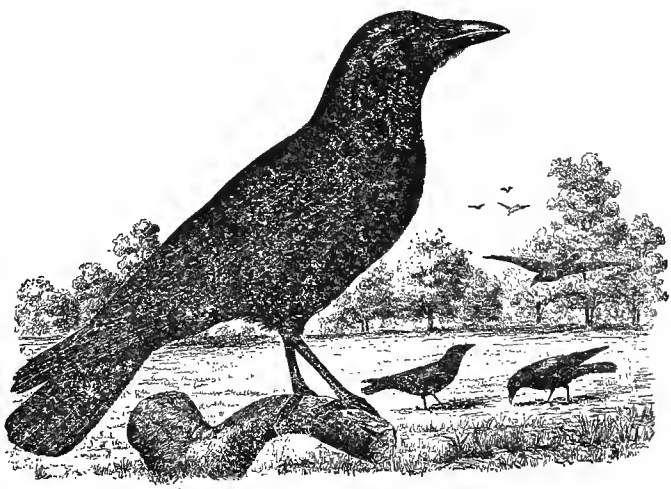
To sum up, practically all of the vegetable food of the painted bunting is of weed seeds, two-thirds of it being the seeds of foxtail grass, one of the worst weed pests. The animal food also is composed almost exclusively of injurious species, more than a fourth of it consisting of the two greatest pests of the cotton crop—the cotton worm and the boll weevil.—W. L. M.

COMMON CROW.[1]

Though not possessing the proverbially bad reputation of its kin of the Northern States, the crow (fig. 8) of the South is well known in a large part of the area of which this bulletin treats. Throughout the coastal region east of Texas it is intimately associated with its maritime relative, the fish crow,[2] and in winter these two have much the same food habits.

The series of 108 stomachs available for examination, while too few to show accurately the food habits of the crow over so large an area, has verified much of the information gained from field observation. The food of the crow of the South is much like that of its northern relative, such differences as are observed being due to the relative abundance of certain food items in the two areas. The southern crow has many of the virtues of the northern bird, and, so far as the evidence at hand shows, certain corvine failings, as nest robbing and injuring sprouting corn, seem less pronounced.

Examination of stomachs revealed 31 per cent animal food and 69 per cent vegetable. Insects comprised a little less than a fifth of the yearly sustenance, and were made up of many of the common pests, as May beetles and their larvæ (white grubs), which were eaten in every month save two; weevils of several kinds; grasshoppers (nearly 5 per cent); and several species of caterpillars. Such beneficial insects as predacious ground beetles and bugs and parasitic hymenopterans formed less than 2 per cent.



B2148-53

FIG. 8.—Crow. Length, about 19½ inches.

Crustaceans, by far the largest part of which were crawfish, constituted an important food item (7.4 per cent). These creatures in some sections of the South are the cause of considerable damage, especially to corn and cotton. A few mollusks, amphibians, and fish (about 4 per cent) indicate the aquatic feeding habits of these birds. Fragments of the shell of a hen's egg found in one stomach supply the only evidence of that objectionable trait of which the northern crow is so frequently accused. No remains of wild birds or their eggs were found.

In the vegetable food, corn and wild fruits stand out prominently. The former constituted about a fourth of the yearly subsistence, but a large portion was taken in winter when it must have been secured from outstanding shocks or picked up as waste. Such wild fruits as sour gum, poisonous and nonpoisonous sumacs, pokeberry, blackberries, greenbrier, and the like composed nearly a third of the food, and were so prominent probably because of the great abundance of many of these plants throughout the South. Grain, other than corn, and a little cultivated fruit also were taken.

Field observation has shown that certain other items not revealed by laboratory examination enter into the diet of the southern crow. Watermelons are frequently

[1] *Corvus brachyrhynchos.* [2] *Corvus ossifragus.*

damaged, and small gardens have suffered losses in peas, strawberries, and peanuts. Growers of pecans also have entered complaints against the crow. In many sections the bird has been credited with being a most potent disseminator of live-stock diseases, especially hog cholera. While he may be one of many distributors of these diseases, ultimate remedies depend upon close attention to sanitation and quarantine rather than the destruction of all possible carriers. As a carrion eater, the crow renders the farmer an important service, especially in the South.

In view of the fact that corn pulling may be largely prevented by the use of deterrents, as coal tar upon the seed; that loosely made corn shocks, left standing long after the corn should have been properly stored, are a constant attraction for these birds; that damage to poultry and their eggs may be largely obviated by the proper housing of nesting fowls and the screening of chicks; and that much can be accomplished by scarecrows and other frightening devices, it appears that the legislation regarding the crow at present in force in the Southern States is satisfactory. Absolute protection is not afforded in any of these States. This allows the crow to be held in check when doing damage, yet the absence of extensive campaigns of destruction permits it to continue unmolested, in large measure, its good work in the destruction of insect pests in spring and summer.—E. R. K.

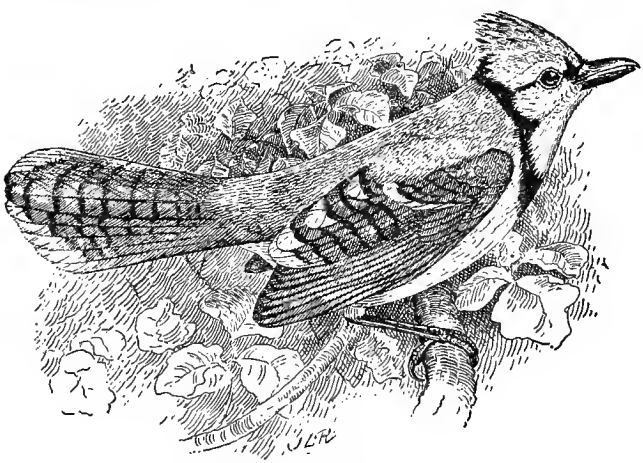


FIG. 9.—Blue jay. Length, about 11¾ inches. B2149-53

BLUE JAY.[1]

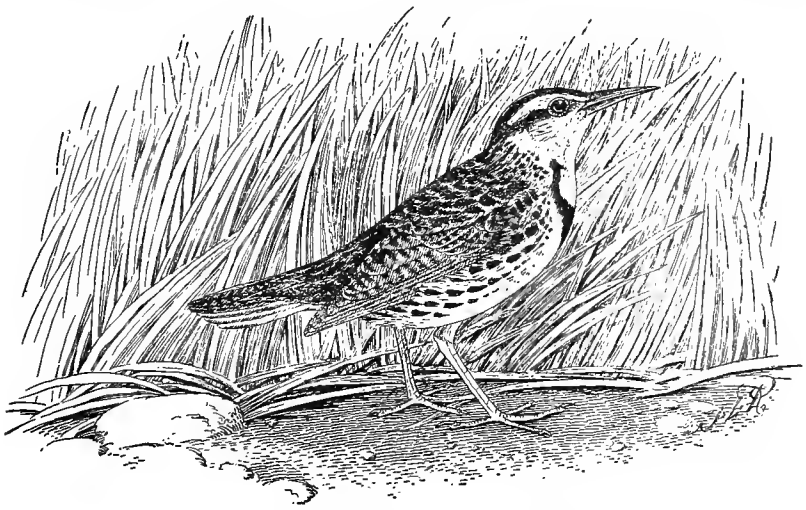
In the Southern States the blue jay (fig. 9), or "jaybird" as he is more familiarly known, is a resident the year round, and in winter his numbers are swelled by migrants. Stomach examination shows that he possesses essentially the same food habits as his relatives in the North, while such differences as do occur are somewhat in favor of the southern bird. Complaints from agriculturists and sportsmen appear to be less frequent and severe in this area, while bird lovers have had less to say regarding the jay's habit of nest robbing, though this may be in part due to the fact that the movement to foster small insectivorous and game birds has not attracted so much attention here as in some sections farther north.

Examination of 184 stomachs indicates that animal food forms 31.9 per cent and vegetable 68.1 per cent of the total. Insects make up 26.5 per cent of the yearly sustenance, an increase of about 4.5 per cent over the northern bird; this is the strongest point in favor of the southern jay, especially since in this food are many of the most destructive pests, foremost among which are caterpillars and grasshoppers, in about equal quantity. Common articles in the blue jay's diet are scarabæid beetles, including May beetles, euphorias, and other related species, all of which, in one stage or another of their development, are highly destructive to vegetation. In May, when the first of these are abundant, they comprise nearly three-tenths of the food. About wood lots the jay renders particularly valuable service in his choice of insect food.

[1] *Cyanocitta cristata*

Important elements include both the flat-headed and round-headed wood borers, as well as numerous weevils, those feeding on pine predominating. Beneficial insects, including predacious ground beetles and bugs, and parasitic hymenopterans comprise about 9 per cent of the yearly food. The jay's liking for snails, which furnish an ample supply of animal matter at times when insects are scarce, appears to be akin to the southern crow's preference for crawfish. A few batrachians (toads and frogs), lizards, and even fish help out when hunting is not at its best. Of the 184 stomachs examined only one contained the egg of a small bird; shells of hen's eggs occurred in 13 of these, but as the jay is given to rummaging about rubbish piles, the source of some of this material may be thus explained.

A consideration of its vegetable food discloses evidence unfavorable to the southern blue jay. Of cultivated fruit and corn he takes considerably less than the northern bird, but on the latter food he lays heavy toll just at the time when the grain is in the roasting ear and ripening. In fact, in August, corn closely associated with the silk torn from the top of the ear was found in 11 of 15 stomachs, forming over 58 per cent of the monthly food. This item was also well represented in stomachs collected in July and September. But by far the most popular article of diet of the southern



B2150-55

FIG. 10.—Meadowlark. Length, about 10¾ inches.

jay is mast, which composes nearly 46 per cent of the yearly food, and in January, when other food is scarce, runs as high as 84 per cent. Complaints against the bird on this score are few as yet, but this liking for mast may lead him into trouble with growers of cultivated nuts—pecans, for instance.

While there may be possibilities of the southern jay becoming troublesome locally, at present he can not be considered a serious menace to agriculture. His insectivorous diet during spring and summer, which includes many destructive species, more than compensates for the losses inflicted upon cornfields later in the season, or upon isolated orchards of cultivated nuts.—E. R. K.

MEADOWLARK.[1]

The meadowlark (fig. 10) is a familiar bird of grassland throughout the whole United States, though less abundant in the Southwest. Alike on eastern meadows, western prairies, and southern savannas, its clear pipe may be heard in spring

[1] *Sturnella magna.*

announcing the return of the season of procreation and growth. For its home it chooses level, slightly undulating land free from trees, and, if possible, with a supply of water near at hand, for the meadowlark delights in a clear running brook for drinking and bathing. Its nest is built on the ground among the dead herbage of the last year's growth, and is usually overarched to protect the eggs and the sitting bird from the weather, and is often so completely buried from sight as to defy detection by the most skillful searcher. The bird's preference for unmown fields covered with what farmers call "old fog" has given rise to the name of "old-field lark," by which it is known in many places.

The great bulk of the species is migratory from the Northern States, but from the latitude of Pennsylvania southward the bird is found throughout the winter, its numbers somewhat increasing farther south.

As a rule, farmers have made little complaint of this bird, but a Georgia farmer says that meadowlarks and crows do much harm to his corn and oats when first planted; that they seem to pull up the sprouting seed for the fun of it, as they do not eat half what they pull up; and that the meadowlarks are much more destructive than the crows. A Tennessee farmer reports that the meadowlarks eat clover seed (presumably newly sown) to an injurious extent. As these are the only complaints of any consequence against this bird, among thousands relating to damage done by others, it would appear that the habits of the meadowlark do not seriously conflict with the interests of the farmer. This supposition is fully substantiated by the results of examination of the bird's food, and it is still further shown that, so far from being injurious, the meadowlark is one of the most useful allies of agriculture, standing almost without a peer as a destroyer of noxious insects.

In the laboratory investigation 890 stomachs were examined, representing all the southeastern States, and every month of the year. Analysis of the contents showed animal food, chiefly insects, 78.12 per cent, and vegetable, 21.88 per cent.

As illustrating this bird's vigilance in its search for insects, an instructive lesson may be drawn from the food of a group of six birds taken when the ground was covered with snow. The stomach having the least insect food contained 8 per cent; that with the most had 95 per cent; and the average for the six was over 47 per cent, or nearly half the total food. The insects consisted of beetles of several species, true bugs, grasshoppers, crickets, a few wasps, caterpillars, spiders, and myriapods. It thus seems evident that insects are essential to the diet of this bird and that great efforts are made to obtain them even under very adverse circumstances.

Of the insect food of the 890 birds, by far the most important elements were grasshoppers, long-horned or green grasshoppers, and crickets (27 per cent). In January they form more than 9 per cent of the total food, and increase rapidly until October, when they reach the surprising total of 56 per cent. During the succeeding months they decrease slowly, and in November still constitute 40 per cent. It is extremely doubtful if any other bird will be able to show a better record for the destruction of grasshoppers. One stomach examined contained 37 individuals; but it should be borne in mind that the birds that form the subject of this paper were not collected from any region specially infested, but were gathered from all parts of the Southern States, and of the whole number, 466 contained grasshoppers.

Beetles of many species stand next to crickets and grasshoppers in importance, and constitute nearly 18 per cent of the annual food. One of the most harmful of these is the family of the May beetles or leaf chafers, the average consumption of which amounts to about 9 per cent for the year, and the greatest, 28 per cent, in May. Most of these are dung beetles, but remains of the well-known May beetles were found. Snout beetles, or weevils, form a small but very constant element of the food (about 4 per cent). Beetles belonging to about a dozen other families collectively constitute about 3 per cent of the whole food. Of importance in considering the diet

of every bird is the extent to which it eats predacious ground beetles. From its habits the meadowlark might be expected to feed largely upon these beetles, as they live upon the ground for the most part and are very abundant. Examination shows that these insects constitute somewhat more than 11 per cent of the food of the year. When it is considered how exclusively the meadowlark feeds upon the ground, this is certainly a very moderate exhibit and would seem to indicate that the bird does not especially seek for these beetles but simply eats such as fall in its way.

True bugs are eaten with fair regularity by this bird throughout the year, averaging 3 per cent of the food of the season. The greater number are of the family of stink-bugs, some of whose members are familiar (by taste) to many who have eaten raspberries from the vines; these will wonder at the taste of a bird that can habitually eat such highly seasoned food. Three specimens of the notorious chinch bug were found, and it is gratifying to know that the meadowlark will eat this insect which has done millions of dollars damage in this country.

Caterpillars, or the larvæ of butterflies and moths, form a very considerable portion (nearly 13 per cent) of the food of the meadowlark, but, as with most other birds, the adults are rarely eaten, only 3 small moths having been found in as many of the 890 stomachs. Caterpillars were found in every month, and even the stomachs taken in December show over 2 per cent. The maximum (28 per cent) is attained in May.

Spiders and myriapods (thousand-legs) are eaten freely, and aggregate nearly 3 per cent of the food. Other insects eaten include flies, found in a few stomachs; a dragonfly in one; an earwig in one; and a common cattle tick in one. Snails or fragments of their shells were found in seven stomachs, sowbugs in two, a small crustacean in one, and the bones of small frogs or toads in three. These last were from stomachs taken in Florida and do not seem to be a favorite food.

The vegetable food of the meadowlark comprises 21.88 per cent of the total, and may be roughly divided into fruit, grain, and weed seed. Fruit is mostly of wild species and amounts to less than 2 per cent. Grain of three kinds—corn (the favorite), wheat, and oats—constitutes a little less than 9 per cent, and was mostly taken in winter, showing conclusively that it was waste. No sprouting grain was found. Weed seeds, chiefly ragweed, barngrass, smartweed, sorrel, mustard, amaranth, and gromwell (about 7 per cent), like the grain, were mostly eaten in winter. In the analysis of the stomach contents clover seed was especially looked for, as the meadowlark has been accused of eating this to an injurious extent, but it was found in only six stomachs and only a few seeds in each—some with only one.

Stomach analysis does not indicate that grain is preferred to other seeds. The quantity of each taken is practically the same and in such a grain-raising country as this it can not be urged that this food is less easily obtained than the seeds of weeds. When meadowlarks collect in flocks, as they sometimes do, they may do some damage to grain, but at the time of the harvest of wheat and oats they are not thus congregated, and the stomach records show that at that season practically none of these grains were found, it being the time when insects were most abundant and constituted nearly the whole food.

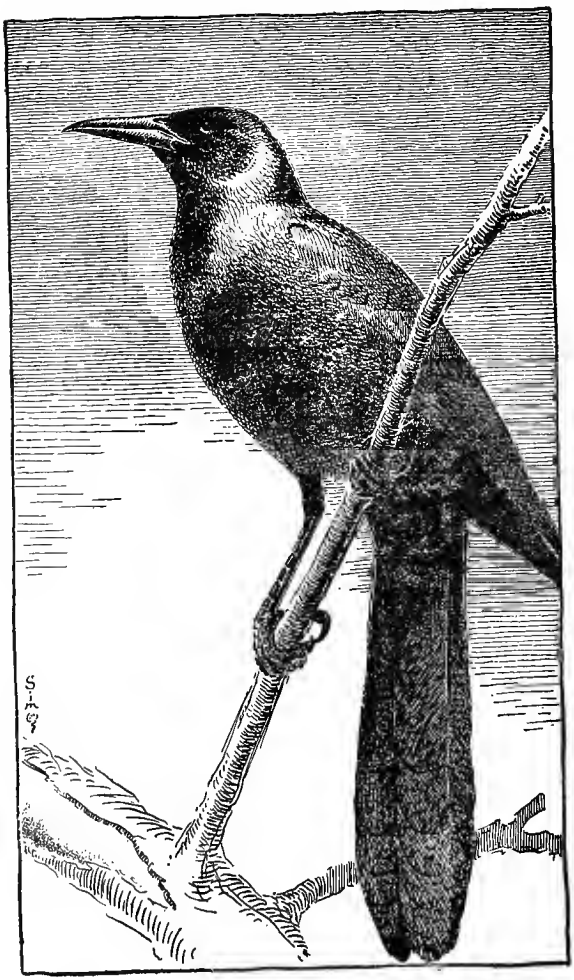
Unfortunately for the meadowlark, its body is plump and its flesh well flavored, and as it is easily killed the temptation is too great for some persons to resist. But it is most emphatically a case of "killing the goose that lays the golden eggs." The small portion of food that the creature's body yields is as nothing compared with the good the bird does when alive. The tendency to treat the meadowlark as a game bird is far too general, and every farmer on whose land it is found should rigidly protect it and allow it to breed undisturbed. When its numbers have so far increased as to render it dangerous to crops will be soon enough to begin the thinning-out process, but that day is still far distant in most parts of the country.—

F. E. L. B.

BOAT-TAILED GRACKLE.[1]

The boat-tailed grackle (fig. 11), the largest of the blackbirds in the United States, inhabits the South Atlantic and Gulf States from Virginia to Texas but is not found at any great distance from the coast. Little has been written concerning its food habits, but Audubon, whose account is apparently the best, says:

> The food of this species consists principally of those small crabs called "fiddlers," of which millions are found along the margins of the rivers and mud flats, as well as of large insects of all kinds, ground-worms, and seeds, especially grains. * * * In autumn, while the rice is yet in the stack, they commit considerable mischief by feeding on the grain, although not so much as when it is in a juicy state, when the planters are obliged to employ persons to chase them from the fields.[2]



B2161-55

FIG. 11.—Boat-tailed grackle. Length, about 16 inches.

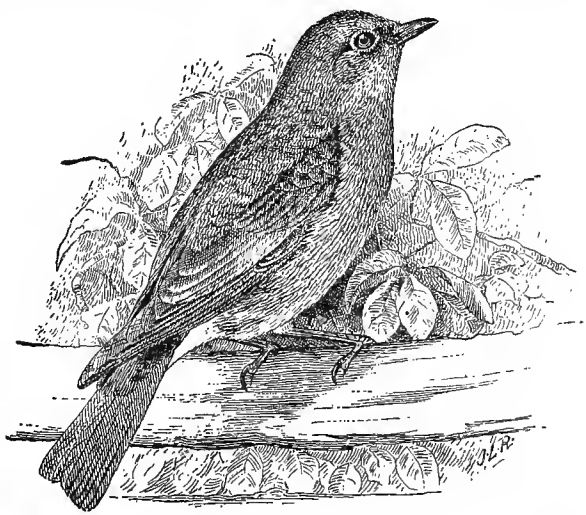
In the investigations made by the Biological Survey there have been examined 247 stomachs from Florida, Alabama, Mississippi, Georgia, and Texas, representing every month in the year. The food consists of 47.45 per cent animal matter and 52.55 per cent vegetable. The former is made up of insects and crustaceans, with a few lizards, toads, frogs, small mammals, etc. Crustaceans make up more than a third of the animal food (16.81 per cent of the total) and consist of crawfish, crabs, and shrimps, a true seashore diet. No insects appear to be specially sought. Predacious beetles (3.23 per cent) are taken mostly in fall, and other beetles are found to some extent, but no family is conspicuous. Grasshoppers are eaten in July and August (34.47 and 30 per cent, respectively) but very few in any other month. The average for the year is 7.76 per cent. Six birds taken in Texas in September are worthy of special mention from the fact that they had all eaten cotton bollworms in quantities varying from 26 to 93 per cent of the food. A few other insects and remains of small vertebrates are frequently found in the stomachs, but do not form important elements.

---

[1] *Megaquiscalus major.*

Grain (35.65 per cent), all but a mere trace of which is corn, composes part of the food of every month except May—the only stomachs collected in this month came from a rice field near Savannah, Ga. In each month except May and November corn constitutes more than half the vegetable food. October shows the greatest quantity (71 per cent of the total food), but as only five stomachs were taken in this month this result can hardly be regarded as a fair average. The pulp of some large seed or nut, not otherwise identified, was next in importance to corn. Remains of figs in several stomachs and wild grapes in one, indicate that fruit is eaten, though sparingly. No weed seeds were found.

It is thus evident that no very salient points in favor of the boat-tailed grackle have come to light. In its insect food it has no very pronounced preferences, and while it does not cause great havoc among useful insects, it does not prey extensively upon harmful ones. In common with most other land birds, it eats grasshoppers freely in July and August, and shows a taste for caterpillars as well. The animal food it decidedly prefers is small maritime crustaceans, and these, so far as the interests of agriculture are concerned, are entirely neutral. In its vegetable diet, the bird certainly does not commend itself to the agriculturist. Its preference for corn is very marked and shows no variation with the change of season. That it visits the growing crop for its supplies is evident from the fact that much of the corn found in the stomachs during early summer is "in the milk." In any locality, therefore, where this grackle is very abundant it must almost necessarily be harmful to the corn crop without rendering any well-defined service in return.—F. E. L. B.



B2152-73

FIG. 12.—Bluebird. Length, about 7 inches.

BLUEBIRD.[1]

Typical of all that is pleasing in bird life generally, the bluebird (fig. 12) is especially cherished wherever it is found, and on esthetic grounds alone is carefully protected. It ranges in the breeding season throughout the United States east of the Rocky Mountains, and remains in winter as far north as the southern parts of Illinois and Pennsylvania. It is one of the most domestic of our wild feathered friends and readily takes possession of the box erected for its accommodation where it can be safe from cats and other prowlers, or utilizes crannies of farm buildings for its nest; its original homes, however, were in such places as deserted woodpecker-holes or cavities in old stumps. These birds are usually abundant wherever found and their numbers are maintained by the rearing of two and frequently three broods a year, with from four to six young in each. The food supply for such large families may well concern the farmer, and he will be interested to learn what these birds relish most.

For studying the food of the bluebird 244 stomachs from the Southeastern States were available, and the contents, 58.51 per cent animal food and 41.49 per cent vegetable, well demonstrate that the bird is as deserving of protection on economic grounds as it is for esthetic reasons.

[1] *Sialia sialis*.

In the animal food the largest portion is made up of orthopterous insects (grasshoppers, crickets, and katydids), totaling 20.53 per cent for the year. Most insects of this group are harmful and at times very destructive. Second in importance in the diet are beetles (18.79 per cent), made up in part of useful ground beetles (10.38 per cent of the total food), but in this item also are May beetles (3.9 per cent), weevils, or snout beetles (1.13 per cent), and miscellaneous related forms (3.38 per cent). The useful beetles are sometimes eaten in such numbers as to detract from the esteem in which the bluebird is held, the month of May, for instance, charging them against the bird to the extent of 36.61 per cent of the food, and every month recording them in such quantities as to indicate that they are very palatable to the bluebird. Few birds exceed this record of destruction of useful beetles, but it must be remembered that for the year they form only about one-tenth of the food, and that the remaining food shows that insects as a whole are attacked so impartially that the balance of nature is not disturbed, and while one kind of insect life is not exterminated another is not allowed to become superabundant; grasshoppers, for instance, enter the food of the bluebird about in proportion to their abundance.

The group third in order of importance in the animal food contains the many forms of caterpillars, including a few moths (9.59 per cent). Chief among these are the owlet moths, the larvæ of which are the well-known cutworms, but there are also included hairy caterpillars and the "yellow bear." The rest of the animal food is made up of flying insects, as wasps, bees, and flies, in small quantities, for the bird is not very active on the wing; of ants and bugs, among which latter stinkbugs predominate; remains of chinch bugs, detected in one stomach; a few spiders (2.47 per cent); still fewer myriapods, or thousand-legs (1.23 per cent); a mere trace of sowbugs and snails; and a few bones of lizards and tree frogs.

The vegetable food consists largely of fruit obtained from pastures, swamps, and hedgerows, rather than from gardens and orchards. Practically all the domestic fruit taken was secured in June and November, and the only cultivated species identified were cherries and raspberries or blackberries. In December, wild fruit forms two-thirds of the monthly food, but this item decreases gradually each month, and in May no fruit of any kind is taken. The yearly average is about a third of the total food. As fruit is taken chiefly in winter, it follows that it is eaten to tide the bird over until insects are again abundant, partly taking the place of seeds in the winter diet of birds in general, though seeds, too, are occasionally and sparingly eaten by the bluebird. Among them are seeds of sumac of both harmless and poisonous kinds, bayberry, and a little indeterminate vegetable refuse and rubbish, together averaging 7.21 per cent of the yearly food.

The bluebird has never been accused, in the writer's knowledge, of objectionable habits, and cultivated crops are not only safe from its attacks, but are benefited by its ridding them of an overabundance of harmful insects. In spring and early summer, when berries and small fruits are at their best, the bird subsists upon insects to the extent of five-sixths of its food. Its fruit-eating period is from late fall to early spring, when insects are scarce and waste fruit available. The point that has been urged against the bird, its destruction of predacious beetles, is a harmful trait more apparent than real, inasmuch as its record on all other lines is absolutely in its favor. Field observation and laboratory analysis of the food fully justify the high esteem in which the bird is held, and there is not the slightest excuse for persecuting it or withdrawing from it the smallest degree of protection.—F. E. L. B.

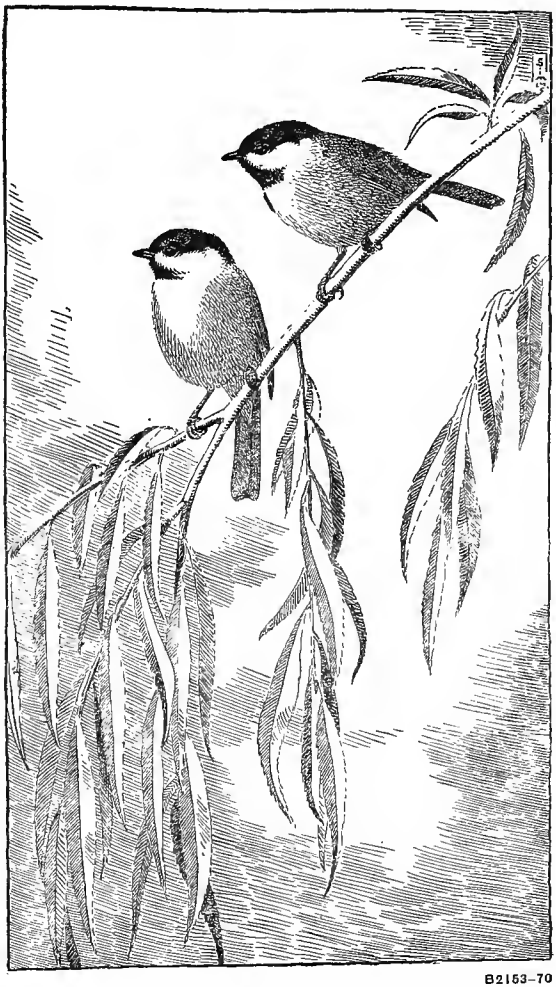
CAROLINA CHICKADEE.[1]

The Carolina chickadee (fig. 13) ranges through the southern portion of the United States from the Atlantic to the Rockies and north to the Ohio River and to some extent beyond. Its nest is built in hollow trees or posts, or in boxes set up for its special

[1] *Parothestes carolinensis.*

accommodation. A bird of forests and groves, it is not found on treeless areas, and does not often alight upon the ground. From this it follows that its food is mostly of the kind that can be taken on trees or bushes, and, therefore, excludes such ground-inhabiting insects as ants and grasshoppers.

The study of the food habits of the Carolina chickadee is based upon an examination of the contents of 210 stomachs collected in the Southeastern States. The food consisted of 71.94 per cent animal matter and 28.06 per cent vegetable, the former being made up of insects and spiders with a few sowbugs, found in one stomach, and the latter of berries and several kinds of seeds.



B2153-70

FIG. 13.—Carolina chickadee. Length, about 4½ inches.

Beetles, being rather terrestrial in habit, escape the chickadees to some extent, forming only 3.67 per cent of their food. Nearly half of these were snout beetles, or weevils, of which practically all species are more or less harmful and many are pests. The predacious ground beetles apparently elude these birds completely, for not a trace of one was found in any of the 210 stomachs.

A few ants were taken in the months from February to June, except May, but the average for the year is only 0.36 per cent. Bees and wasps (4.48 per cent of the food of the year) were taken oftener and more regularly. The month of greatest consumption was February, which would appear to be rather early for bees and wasps to be out extensively, and March stands next.

Bugs seem to be a favorite food in the four months from April to July, during which the great bulk is eaten. The average for these months is 15.13 per cent, but for the whole year it is only 5.68 per cent, as bugs were eaten in only three of the other eight months and then but sparingly. This item of food is made up of stink-bugs, shield bugs, leafhoppers, tree-hoppers, plant lice, and scales. While no special pest was noted, nearly all of these are harmful and especially the last two, of which there are hundreds of species and nearly every plant has its own peculiar form.

The real food of the Carolina chickadee consists of moths and caterpillars. Moths were found in only 1 stomach, their pupæ in 16, their eggs in 20, and their larvæ

(caterpillars) in 138, or about two-thirds of those examined. The month of greatest consumption is October, when they amount to more than three-fourths of the food (78.1 per cent). The month of least consumption is December, when they still aggregate more than a tenth of the yearly food (11.74 per cent). The average for the year (44.42 per cent) is exceeded by cuckoos, but by few if any other birds. Chickadees have a habit of beating their prey to pieces on a branch of a tree before swallowing it, so that the stomachs contain only fragments not easy to identify. It is probable that in these were many notorious pests, for the pupæ of codling moths were recognized in five stomachs and the eggs that produce one of the tent caterpillars in two.

Like many other tree-inhabiting species, the Carolina chickadee eats very few grasshoppers, but some were taken irregularly through the year (1.04 per cent). In five months, including August, the grasshopper month, none were eaten at all, and but few at other times. So far as stomach records show no genuine grasshoppers were eaten, but only some of their allies in their lowest or first stage, viz, the egg. In 11 stomachs were found the eggs of katydids; in 5 the egg cases of cockroaches; in 1 a grasshopper's egg; and in another a cricket's jaw.

Flies are practically ignored. What were probably the eggs of a crane fly were found in one stomach, but no adult flies were noted.

Spiders seem very palatable to the chickadee, being eaten every month and showing a higher percentage (10.9 per cent) in the stomachs than any other animal food except caterpillars. In five stomachs collected in March they amount to 44.6 per cent, but a greater number of stomachs would probably modify this record. One stomach was practically filled with the remains of sowbugs. These appear to be the only animal food eaten that can not be obtained from a tree, shrub, or weed, and it is not clear how the chickadee could get them, for sowbugs are essentially terrestrial in habit and are usually found under a stone, clod, or mass of practically decayed vegetation. A few bones and other tissues of a small unidentified vertebrate taken in June complete the animal food.

The vegetable food of the Carolina chickadee consists chiefly of fruit and seeds. Blackberries or raspberries, found in two stomachs; blueberries, in one; and fruit pulp not further identified, in five, constitute 2.17 per cent of the food for the year. Seeds of poison ivy (10.07 per cent for the year) appear to be a favorite food in the colder months, but only the waxy coating is eaten. This is taken off and swallowed and the real seed rejected, so that the bird does not aid in the distribution of this noxious plant as do so many birds that swallow the seeds and afterwards either disgorge them or pass them through the alimentary canal to fall and germinate in a different locality.

Other seeds, most of them so broken and ground up as to be unidentifiable, were eaten to the extent of 12.38 per cent, chiefly in the colder months. In nine stomachs taken during this season were pieces of liverwort, a plant of the lower order that grows upon the bark of trees or damp rocks. This seems a very curious food for a bird, and is probably taken when other supplies are scarce.

In a résumé of the food of the Carolina chickadee, one is impressed with the fact that a large proportion consists of the eggs, pupæ, and larvæ of noxious insects. As an enemy of caterpillars the bird has few peers. It also destroys a great many of those two pests of horticulture, plant lice and scales.—F. E. L. B.

TUFTED TITMOUSE.[1]

The tufted titmouse inhabits the whole of eastern United States from the Gulf to southern Iowa and northern New Jersey. It is contented with various kinds of surroundings and will nest as readily in a box erected in the dooryard or garden as in the midst of the deep forest. Its preferred nesting site is an old woodpecker-hole or an unoccupied box put up for a wren, and it usually remains in the vicinity of its nest

[1] *Bæolophus bicolor.*

during the year. It is a rather noisy bird and keeps up its monotonous cry with tiresome iteration. In winter small flocks assemble, probably family groups, and ceaselessly wander about the forest in search of food, scrambling about the trunks and larger branches of trees for hidden insects and their eggs. At such times, they are very tame and pay little attention to human intruders. At the approach of spring they separate into pairs.

For investigating the food of the tufted tit 186 stomachs were examined. These were too few and too irregularly distributed through the year to afford more than an approximation of the bird's economic worth. The food consisted of 66.57 per cent animal matter to 33.43 per cent vegetable. Contrasted with the food of the brown thrasher, in which no one article predominates, that of the tufted tit includes one item, caterpillars, which forms more than half the animal food, and two items, caterpillars and wasps, which are more than half the whole food.

Beetles make up 7.06 per cent of the subsistence, and of these only one-tenth of 1 per cent are useful species. More than two-thirds of the beetles (4.94 per cent) are snout beetles, or weevils. Among these the cotton boll weevil was found in four stomachs. The remainder (2.02 per cent) are of various families, all harmful.

Ants are eaten by this tit occasionally, but in the light of present evidence can not be considered a standard article of diet. Other hymenopterous food, i. e., bees, wasps, and sawfly larvæ, is eaten much more extensively (12.5 per cent), and as the sawfly larvæ predominate, the winged forms are not in the majority among the hymenopterans. The tufted tit, like the cuckoo in this respect, takes many sawfly larvæ when searching for caterpillars.

Bugs, principally stinkbugs, tree-hoppers, and scales, or bark lice, are eaten to a moderate extent (4.03 per cent) in seven of the twelve months. Their absence from September to January, inclusive, would probably disappear with a greater collection of stomachs. Scales were the most numerous of the bugs, and in two stomachs specimens of the European fruit scale were identified. In one stomach, and this taken in January, were found the remains of a single fly; from this record it may safely be asserted that flies are not a favorite food of this bird.

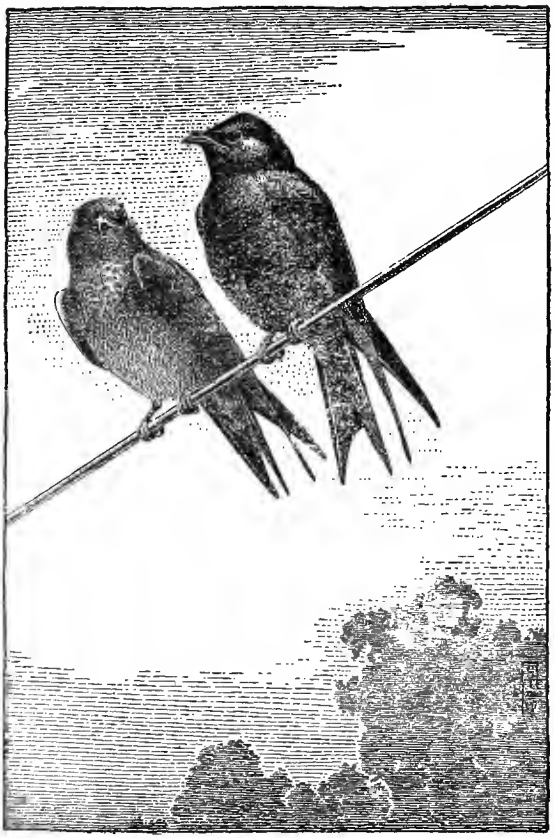
Caterpillars apparently stand at the head of the dietary of the tufted tit, aggregating more than half the animal food for the year (38.31 per cent). They were eaten in every month but one—November. Of six stomachs taken in that month not one contained caterpillars, although both October and December stomachs show fair percentages. The one stomach taken in August gives that month the highest of any, 76 per cent. The titmouse is so small a bird that the caterpillars eaten are mostly torn in pieces before being swallowed, thus making identification difficult or impossible, but the cotton leaf worm was identified in one stomach. No grasshoppers or crickets were found. The only traces of orthopterous insects (0.42 per cent) were eggs of katydids, egg cases of cockroaches, and a jaw and an ovipositor thought to be of a grasshopper.

Spiders are picked up in moderation and rather irregularly. They are evidently a makeshift food, and were found in 40 stomachs examined in May (12.67 per cent), 7 stomachs in June (a mere trace), and 3 stomachs in July (16.33 per cent). Thousand-legs were not found. A few snails make up the remainder of the animal food.

Of the vegetable food, corn was discovered in one stomach, evidently taken on trial. Fruit was eaten to a moderate extent (5.15 per cent), mostly in midsummer, and included raspberries, blackberries, and strawberries, which might have been of cultivated varieties, but probably were not. The wild fruits were such as grow by the wayside and in swamps, as elderberries, hackberries, blueberries, huckleberries, and mulberries. Seeds of various kinds, as sumac—including poison ivy—bayberry, or wax myrtle, aggregate 4.07 per cent. It is difficult to draw the line between broken seeds and mast in stomachs of the tufted tit, but, together considered as mast, these form more than two-thirds of the vegetable food. While largely composed of acorns, there is no doubt that chinquapins and beechnuts and many smaller seeds enter into its composition. As

thus defined, mast amounts to 23.4 per cent of the whole food, comprising 95 per cent of that eaten in November, 50.42 per cent in January, and 55.97 per cent in February; in fact, it is the principal vegetable food eaten from August to February. That such small birds should crush such hard nuts as acorns and chinquapins is surprising, but the broken fragments found in the stomachs well demonstrate their ability.

From the foregoing discussion of the food of the tufted titmouse, it is evident that the bird is beneficial, and so far as this investigation shows it has no bad habits or tastes to offset the good it does by its destruction of noxious insects. If encouraged, it becomes domestic, and, like the wren, lives about the garden and helps to keep in check the hundreds of insects that prey upon the products of cultivation.—F. E. L. B.



B2164-58

FIG. 14.—Purple martin. Length, about 8 inches.

PURPLE MARTIN.[1]

The purple martin (fig. 14), or house martin, as it is more commonly called, occupies the whole of the United States during the breeding season, but is rather more numerous in the South. Its habit of building nests in boxes provided for its express use has caused it to become the most domestic of all swallows. Besides houses erected for them, the birds do not disdain gourds hollowed out and hung on poles. As their food is taken on the wing, clear, open lands, especially low moist meadows, offer them better foraging ground than orchards or groves. While the greater part of their food consists of insects that fly, a few wingless forms, as ants, spiders, and caterpillars, are taken, but these are most likely picked from the tops of weeds as the birds dart past. Some ants have wings at certain times and so become part of the usual fare. In this investigation of the martin's food, 56 stomachs were examined, taken in the five months from March to July, and the contents found to consist entirely of animal matter.

As might be expected, beetles do not occupy a high rank in the food of the martin, most of them being but little on the wing. Together they form only 5.14 per cent of the whole food. Less than 2 per cent are the predacious ground beetles, and less than half of 1 per cent snout beetles or weevils.

[1] *Progne subis.*

Ants (3.68 per cent) were eaten in May, June, and July. Naturally, these were the winged forms, though a few wingless ones may occasionally have been taken. Other hymenopterans, as bees and wasps, are taken much more frequently (14.67 per cent).

True bugs form the largest item of diet of the martin and consist for the most part of the larger flying species, as stinkbugs, shield bugs, and leaf-legged bugs, with some tree-hoppers. They are found in the food of every month and in all amount to 41.41 per cent. The great bulk of the bug tribe are noxious insects and include some of the worst pests of agriculture.

Flies are eaten to the extent of 7.2 per cent, and consist largely of the long-legged crane flies, or "daddy longlegs," so called. Lepidopterans are represented in the stomachs of most birds by their larvæ, commonly known as caterpillars; but the martin, taking its food on the wing, catches the adult insects, the moths, or butterflies. Most of the moths eaten, however, are very small, so that they form only 1.25 per cent of the food. Butterflies were found in only one stomach. Grasshoppers and crickets (3.58 per cent) are eaten principally in May and June, instead of August, which, with most birds, is the usual month for eating grasshoppers.

A somewhat peculiar article of the martin's diet is the remains of large dragonflies, found in 29 of the 56 stomachs examined. Six stomachs were entirely filled with these rather formidable looking creatures. As dragonflies feed upon mosquitoes and other small insects, the martin can not be considered as doing man a service by eating them. Besides insects a few spiders also were eaten.

Among the harmful insects destroyed by the martin may be mentioned the clover leaf weevil, found in a number of stomachs, one of which contained upward of 40 individuals. An engraver beetle, a form that does great damage to timber, was found in one stomach and the cotton boll weevil in another. Several stomachs contained honey bees, but all were males or drones.—F. E. L. B.

SCISSOR-TAILED FLYCATCHER.[1]

The scissor-tailed flycatcher (fig. 15) is found chiefly from central and eastern Texas and Oklahoma to southern Kansas during the months from April to October, and casually in western Louisiana, western Arkansas, and southwestern Missouri. It occasionally wanders to far-distant sections, and in winter moves farther south and with few exceptions retires beyond the southern boundary. Like the kingbird, it prefers for nesting sites open country, and it seems to be best suited with prairies or rolling land with scattered trees. In settled territory it takes kindly to orchards and even gardens in the near vicinity of buildings. While generally a quiet bird living on good terms with its neighbors, it displays some of the aggressive spirit of the kingbird as regards crows and hawks, and whenever they appear near its nest attacks them with great vigor.

The following discussion of this bird's food is based upon examination of the contents of 128 stomachs rather irregularly distributed over the seven months from April to October. All are from Texas except one from Florida, which is considerably outside of the bird's usual range. The stomach contents were divided between 96.12 per cent animal food, practically all insects and spiders, and 3.88 per cent vegetable, chiefly small fruits and seeds.

Of the animal food, beetles (13.74 per cent) form a rather constant article of diet. Less than 1 per cent belong to theoretically useful families. The others are practically all harmful. The well-known 12-spotted cucumber beetle, which is often very injurious to the cucumber, as well as to squash vines, corn, clover, beets, beans, peas, and asparagus, was found in one stomach. Snout beetles, or weevils, occurred in a number of stomachs, and the well-known cotton boll weevil in four. Most of the beetles are consumed in May, and the least in June, but as only two stomachs were taken in the latter month the record is subject to revision.

[1] *Muscivora forficata.*

Bees, wasps, and ants are eaten to the extent of 12.81 per cent of the yearly food, which is the lowest record but one for this item among birds of the flycatcher tribe. As a rule this kind of food constitutes one of the most important elements of the flycatchers' diet, as these insects, excepting ants, being almost constantly on the wing during daylight, are peculiarly adapted to these birds' methods of feeding. These eaten by the scissor-tail are mostly of the larger kinds, i. e., bees and wasps, with very few of the smaller parasitic species.

B2155-51

FIG. 15.—Scissor-tailed flycatcher. Length, about 14 inches.

Bugs (10.17 per cent of the diet) were found in 47 stomachs. At least nine families were identified, but stinkbugs were most abundant and were found in 22 of the 47 stomachs. In two stomachs was identified that disagreeable pest, the squash bug, a creature not classified by entomologists in the stinkbug family, but if disgusting oder were the chief requisite, it is well qualified for that honor. Most of the other bugs identified are harmful. Flies (3.8 per cent), found in the stomachs taken in April, May, and September only, do not seem to appeal to this flycatcher; in 8 of the 14 stomachs they were identified as robber flies.

Grasshoppers and crickets, evidently a faverite diet of the scissor-tail, were found in goodly quantity in the food of every menth except April. The average for the year is 46.07 per cent—the highest for any flycatcher. The one stomach taken in October contained these insects to the extent of 86 per cent, but it is probable that the month of maximum consumption is July, when they attain 65 per cent. As this bird is said seldom to alight upen the ground, these insects must be captured during their flights or jumps. In general, grasshoppers and crickets are eaten most by ground-feeding birds, as the meadowlark, while flycatchers take bees, wasps, etc. With this bird the rule seems reversed. Of 128 stomachs, 88 contained grasshoppers or crickets and 8 held no other food.

Caterpillars, with a few moths, constitute a small but rather regular article of diet with the scissor-tail (4.61 per cent for the year), and were found in the stomachs of

every month except October. The cotton leaf worm was identified in several stomachs and the cotton bollworm in one. The latter is a well-known pest in cotton fields and also feeds upon a number of other cultivated plants, including sweet corn, from which it is known also as the corn worm. It preys also upon tomatoes and occasionally upon beans and peas. A few dragonflies, together with miscellaneous insects and spiders, complete the animal food (4.92 per cent).

The vegetable food of the scissor-tail consists of small fruit, or berries, and a few seeds. The total percentage, 3.88, indicates that this is not the favorite, but is taken for variety.

The food of the scissor-tailed flycatcher requires but little study to show that where the bird is abundant, it is of much economic value. The bird selects a diet almost entirely of insects, but in this the useful species are so few that they may be disregarded. Its consumption of grasshoppers alone is sufficient to entitle the scissor-tail to complete protection.—F. E. L. B.

RED-COCKADED WOODPECKER.[1]

The red-cockaded woodpecker (fig. 16) is an inhabitant of the Southeastern States from eastern Texas north to southern Virginia and southern Missouri. Pine woods are its favorite haunt, and a large percentage of its food is obtained from pine trees. No complaints have yet been heard that this bird harms crops or forest trees, nor does analysis of its food indicate that such is the case. So far as shown, it does not frequent orchards or cultivated land.

B2156-46

FIG. 16.—Red-cockaded woodpecker. Length, about 8½ inches.

Ninety-nine stomachs from Georgia, Alabama, Florida, Mississippi, Louisiana, and Texas, representing every month, but not many in each, were examined. Of the total food, 86.08 per cent was composed of insects, and the remainder, 13.92 per cent, of vegetable matter, mostly seeds of conifers.

Useful beetles were found in nine stomachs, and amount to about 2 per cent of the whole food. Other beetles, chiefly the larvæ of wood-boring species, aggregate

[1] *Dryobates borealis.*

15.65 per cent of the annual diet. Of these a number were weevils, or snout beetles. Ants, evidently the favorite food, were eaten to a great extent in every month. December is apparently the month of least consumption (28.93 per cent), and July of maximum (69.6 per cent), but the data are hardly sufficient to give final figures. The average consumption for the year (51.72 per cent) is exceeded by few other birds.

True bugs, many of which are scales, or bark lice, are eaten to the extent of 6.99 per cent of the food. The others are mostly pentatomids, or soldier bugs. Nearly all were taken in the five months from December to April, and two-thirds of them in December and January. These insects, and especially the pentatomids, are lovers of warm weather and sunshine and many live on fruit. It seems probable that this bird gets them from their hibernating places. Grasshoppers, crickets, caterpillars, white ants, spiders, and egg cases of cockroaches, make up the rest of the animal food.

The greater part of the vegetable food, about a tenth of the total, consists of mast, mostly seeds of conifers. This was found in 45 of the 99 stomachs, and appears to

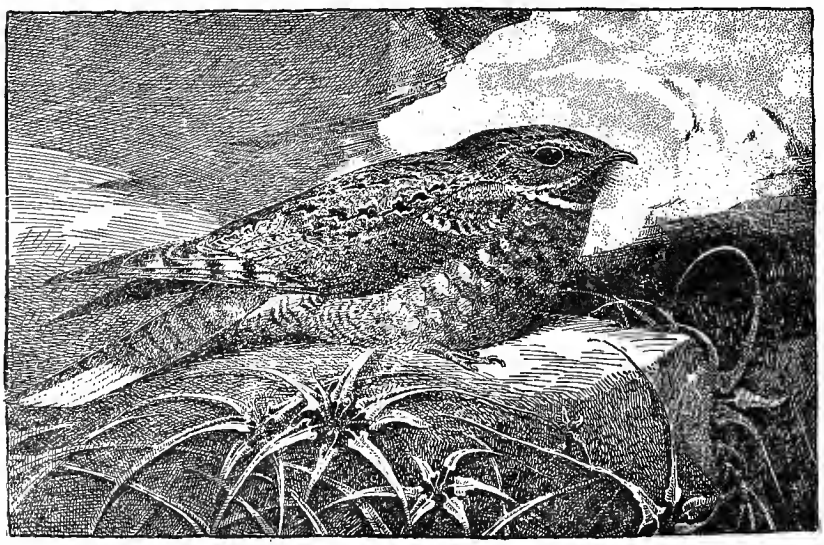


FIG. 17.—Chuck-will's-widow. Length, about 12 inches. B2167-47

be a somewhat regular article of diet, especially in the colder months. Fruit pulp, poison-ivy seeds, bayberry and other seeds, cambium, and rubbish each occurred in a few stomachs, and together amount to about 4 per cent of the food. Corn was found in four stomachs, and unidentified fruit pulp in eight. The cambium was contained in four stomachs, and the seeds of poison ivy in one.

From the foregoing it is evident that the red-cockaded woodpecker does little if any damage to products of husbandry and that it does good work in the forest by devouring wood-boring larvæ. No doubt it aids in distributing the seeds of the pines upon which it feeds, but its food has little other economic interest.—F. E. L. B.

CHUCK-WILL'S-WIDOW.[1]

The chuck-will's-widow (fig. 17), an interesting nocturnal bird, breeds throughout the area to which this bulletin is devoted. Like other species of its family, it lays

[1] *Antrostomus carolinensis.*

only two eggs, which may be deposited almost anywhere on the forest floor, there being no nest. Intrusion on this spot usually results in the bird moving the eggs, which it carries in its mouth.

The bird's flight is noiseless and graceful, and is somewhat more extended and sustained than that of the whip-poor-will but less so than that of the nighthawk. Its call note, which has given rise to the name here used as well as to others of similar sound, is like that of the whip-poor-will, with an added syllable.

The color of the chuck-will's-widow is a harmonious blend of buff, brown, and black, well adapted to concealing the bird as it rests quietly in the woods by day. Surrounding the mouth are numerous branched bristles which with the enormous gape make a very efficient insect-catching apparatus. Although the bird is only 12 inches long, the mouth fully extended forms an opening at least 2 by 3½ inches in size. It is but natural, therefore, that the bird should prey upon some of the largest insects.

Not only are large insects captured and swallowed, but even small birds. Three of the 45 stomachs of the chuck-will's-widow thus far examined contained remains of birds, in two cases warblers. As 42 of the 45 stomachs were collected in April and May, the food percentages apply only to those two months. The percentage made up of small birds is 7.21.

Over 58 per cent of the food is composed of large beetles of the family of leaf chafers. Considerably more than half of these are May beetles, the adults of the white grubs so destructive to forage crops and lawns. Among other destructive beetles of this group eaten by the chuck-will's-widow are the spotted vine chafer, and several others injurious to grapevines and apple trees. There were found also in stomachs of this bird specimens of the southern pine sawyer, a borer that in the South has destroyed timber valued at millions of dollars; beetles of a group whose larvæ bore in roots, sometimes of orchard trees; and the palmetto weevil, which is sometimes destructive to palms.

Moths, mostly of large species, compose 12.36 per cent of this bird's food in April and May, and dragonflies 4.63 per cent. Specimens were taken of the largest dragonfly known to occur in eastern United States. Other items of insect food are water beetles, ground beetles, click beetles (the adults of wireworms), crane flies (injurious to pastures), horseflies, roaches, and green locusts.

Despite the fact that the chuck-will's-widow occasionally devours smaller insectivorous birds, it must be reckoned a useful species. It is probable that birds are not deliberately sought, but that they are taken instinctively, as would be a moth or other large insect coming within reach of that capacious mouth. Generally speaking, therefore, the chuck-will's-widow is insectivorous and most of the insects it eats are destructive.—W. L. M.

NIGHTHAWK.[1]

The nighthawk, or bull-bat, has unfortunately attracted more attention as a target for shooting practice than as an object of esthetic and economic consideration. How many thousands of these useful birds have been sacrificed in this thoughtless way it would be difficult to estimate, but the practice has been extant since early times and has resulted in an enormous reduction in their numbers. What is worse, the nighthawk is particularly unfitted to withstand this sort of persecution, as it lays only two eggs. Thus perpetuation of the species under favorable conditions is only barely assured. That the bird deserves very different treatment there is no sort of doubt. As an adornment of the landscape it has few superiors among birds. A flock of nighthawks pursuing their complex but skillful aerial evolutions is an object of interest and admiration seldom excelled. Not only has the species a pronounced esthetic value, but economically it is practically beyond reproach. The nighthawk is strictly

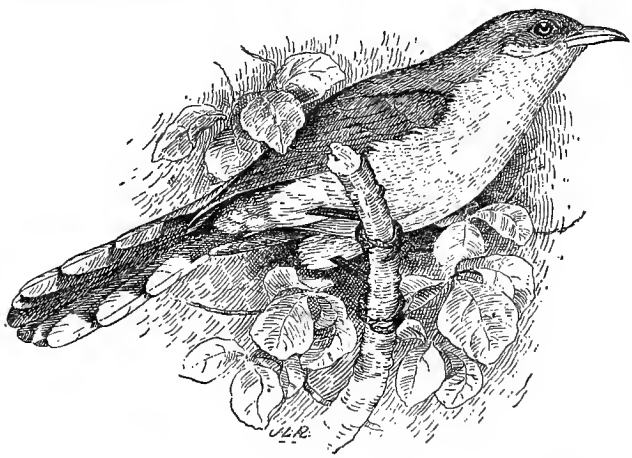
[1] *Chordeiles virginianus.*

insectivorous, and for this reason no blame can be attached to it on the score of its damaging crops. The only charge that can be made against the bird is that it destroys some useful insects, but these are far in the minority.

Nighthawks are so expert in flight that no insects can escape them. They sweep up in their capacious mouths everything from the largest moths and dragonflies to the tiniest ants and gnats, and in this way sometimes gather most remarkable collections of insects. Several stomachs have contained 50 or more different kinds, and the number of individuals may run into the thousands.

Nearly a fourth of the bird's total food is composed of ants. These insects are generally annoying and often very injurious, especially in relation to stored products and in their activities in fostering destructive plant lice. More than a fifth of the nighthawk's food consists of May beetles, dung beetles, and other beetles of the leaf chafer family. These are the adults of white grubs, noted pests, and even as adults many members of the family are decidedly harmful.

Numerous other injurious beetles, as click beetles, wood borers, and weevils, are eaten. True bugs, moths, flies, grasshoppers, and crickets also are important elements of the food, as are several species of mosquitoes, including the transmitters of malaria. Other well-known pests consumed are the Colorado potato beetle, cucumber beetles, rice, clover leaf, and cotton boll weevils, billbugs, bark beetles, squash bugs, and moths of the cotton worm. No fewer than 18 species of bark beetles, which are among the most destructive forest enemies, have been identified in the food of the nighthawk.



B2158-43

FIG. 18.—Yellow-billed cuckoo. Length, about 12¼ inches.

Nighthawks deservedly receive full legal protection everywhere, and citizens should see that the law is obeyed. The nighthawk is far too useful and attractive a species to be persecuted. Especial attention should be given to safeguarding any eggs that may be found. They are deposited on the bare ground or rocks, on logs, or on flat gravel roofs in cities.—W. L. M.

YELLOW-BILLED CUCKOO.[1]

Cuckoos are rather shy birds, keeping among the foliage of trees or bushes and making but little noise. They do not, however, entirely avoid the abodes of man, but where trees are abundant many may frequently be seen about houses or even in the village streets or parks. On very hot mornings in midsummer their familiar though not very musical cry of "kow-kow" is said to presage rain; hence the name "rain crow" by which these birds are frequently known.

The two most abundant species in the United States are the black-billed and yellow-billed cuckoos, but the yellow-bill (fig. 18) is more abundant and better known in the South and probably is the more important economically.

[1] *Coccyzus americanus*.

The common observation that cuckoos feed largely on caterpillars has been confirmed by stomach examination. Furthermore, they appear to prefer the hairy and spiny species, which are supposed to be protected from the attacks of birds. The extent to which cuckoos eat hairy caterpillars is shown by the inner coatings of the stomachs, which frequently are so pierced by these hairs and spines that they are completely furred.

For this treatise 110 stomachs of the yellow-billed cuckoo were available, all but one taken from April to October. That one, secured in Texas in January, was of a bird which had remained in the United States after its companions had moved on farther south; its food consisted of one large harvest fly or "locust" and two or three spiders, the latter very unusual food at this season.

The contents of the other stomachs were practically all animal matter, only a small fraction of 1 per cent of vegetable rubbish being found in one stomach taken in Texas in August and one seed of sour gum in a stomach taken in Alabama in October. Over 92 per cent of the food consists of three orders of insects, viz, bugs (12.25 per cent), caterpillars (65.63 per cent), and grasshoppers (14.34 per cent).

Bugs found in 37 stomachs were nearly all of the larger kinds, like cicadas, stink-bugs, squash bugs, and leaf-footed bugs. They constitute an important article of food from April to August, after which they disappear. July is the month of greatest consumption (29 per cent), and the average for the four months from April to July is more than a fifth of the whole food (21.98 per cent). Among the bugs were the periodical cicadas and several forms injurious to oranges and melons and other cucurbit crops.

Caterpillars were found in 91 stomachs and in 24 they were the sole contents. One of the most important of these is the cotton worm, found in 34 stomachs in numbers varying from 1 to 150 each. At least four held 100 each, and it is probable that the average number of these insects in the 34 stomachs was 50. It is hardly necessary to comment upon the economic importance of this work. Until the introduction of the cotton boll weevil, the cotton worm was the worst pest with which the southern planter had to contend. In the southern tier of cotton States a loss of a fourth of the crop was formerly expected, and if the yield was not reduced a half the planter considered himself fortunate. Examination of many stomachs shows that this insect is a common article of daily food for the cuckoo, as well as for many other birds, and that these birds must exercise a very important restraint upon its increase.

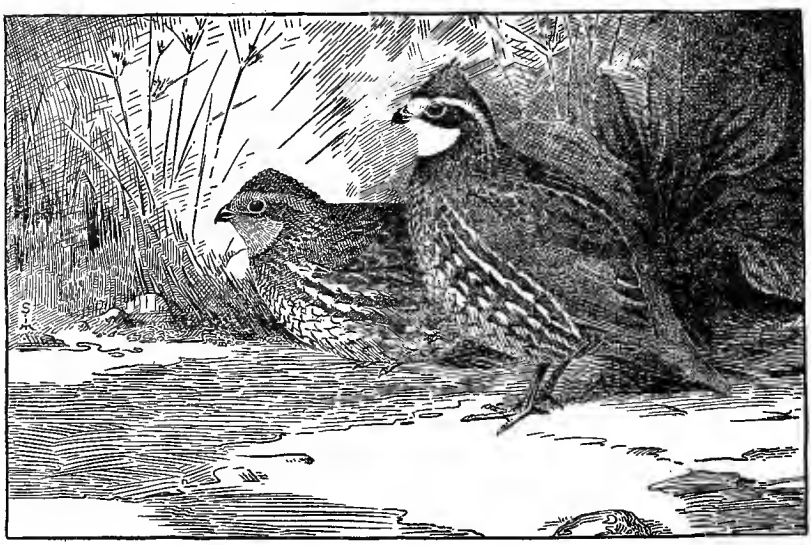
The apple-tree tent caterpillar was found in one stomach. Where apples are grown this insect is a pest, and it is fortunate that there is a bird ready and willing to restrain its ravages. Another caterpillar eaten by the cuckoo was the red-humped apple caterpillar, an insect that feeds in colonies upon apple and other trees and often does considerable damage. In all, caterpillars constitute two-thirds of the total food of the yellow-billed cuckoo in the South. Few birds feed so exclusively upon any one order of insects.

The natural food for cuckoos would seem to be bugs and caterpillars which feed upon leaves, as these birds live in the shade among the leaves of trees and bushes. Not so with grasshoppers, whose favorite haunts are on the ground in the blazing sunshine, yet these creatures are the second largest item in the cuckoo's diet. Grasshoppers are so agreeable an article of food that many a bird apparently forsakes its usual feeding grounds and takes to the earth for them. Thus it is with the cuckoos; they quit their cool, shady retreats in order to gratify their taste for these insects of the hot sunshine. But there are some members of the grasshopper order that live in the shade, as katydids, tree crickets, and ground crickets, and these are all used to vary the cuckoo's bill of fare. Grasshoppers, crickets, and katydids as a whole constitute 14.34 per cent of the cuckoo's diet.

Beetles (3.16 per cent), eaten so extensively by so many birds, are of minor importance in the diet of the cuckoo. Only a trace of the predacious ground beetles

was found. The others were divided into small portions among several families, and no special pest among them was noted. Ants, wasps, and bees comprise less than 1 per cent and are evidently not favorites. A few spiders are taken, mostly in June, and a few moths also are eaten, but the most unexpected food for a cuckoo was three small tree frogs, found in as many stomachs.

As the birds discussed in this paper were collected from a limited area, it will be of interest to take a glimpse at some facts obtained by the examination of stomachs of the same species taken in all parts of the United States. Of a total of about 300 stomachs, the Colorado potato beetle was found in 4; the dog-day harvest fly, or "locust," in 33; the cotton worm in 37, many stomachs containing over 100 individuals; the yellow-necked apple caterpillar in 34, many stomachs completely filled with them; the fall webworm in 3, one of which held 250; and the tent caterpillar in 7 stomachs, frequently to the extent of 100 or more individuals each. In all of



B2159-31

FIG. 19.—Bob-white. Length, about 10 inches.

these cases the statements are very conservative, as these larvæ are so soft that they soon become unrecognizable in the process of digestion, and only those recently eaten can be identified.

The yellow-billed cuckoo is a valuable ally of the farmer. It has no objectionable habits, but does destroy many serious agricultural pests, chief among which are the many species of caterpillars, of which this bird makes about two-thirds of its food.—F. E. L. B.

BOB-WHITE.[1]

No bird is better known to country residents than the bob-white (fig. 19). The bird's cheery calls the year round form part of the most pleasant associations of country life, and its neat form and harmonious coloration, and especially its confiding habits, make it a general favorite.

Any brushy fence row serves as a retreat for its nest, or for winter shelter, and weed-covered fields are its favorite feeding places. Weed seeds form more than half the total food and include those of all the worst weed pests of the farm. Among them may be mentioned crab, cockspur, witch, and foxtail grasses, sheep sorrel, smartweed,

[1] *Colinus virginianus*.

bindweed, lamb's-quarters, pigweed, corn cockle, chickweed, charlock, partridge pea, beggar lice, nail grass, rib grass, ragweed, and Spanish needles.

Acorns, beechnuts, chestnuts, and pine seeds make up about 2.5 per cent of the food, and wild fruits about 10 per cent. The fruits include berries of palmetto, smilax, wax myrtle, mulberry, sassafras, blackberries and raspberries, rose haws, cherry, sumac, grapes, sour gum, blueberries, honeysuckle, partridge berry, and a number of others. The bob-white feeds to a slight extent upon buds and leaves, including those of yellow and red sorrel, cinquefoil, and clover.

Grain forms scarcely more than a sixth of the food, but most of it is taken during winter and early spring when nothing but waste grain is available. The habit of gleaning this after the harvest is beneficial to the farm, for volunteer grain is not desirable, especially where it serves to maintain certain insect and fungus pests. Although most of the grain and seed crops grown upon the farm are represented in bob-white's dietary, no significant damage can be attributed to the bird.

Animal food, chiefly insects, composes nearly a sixth of the bird's subsistence. From June to August, inclusive, when insects are most numerous, their proportion in the food is about 36 per cent. The variety of insect food is great and includes a number of the most destructive agricultural pests. Among them may be mentioned the Colorado potato beetle, 12-spotted cucumber beetle, bean leaf beetle, squash lady-bird, wireworms, May beetles, corn billbugs, clover leaf weevil, cotton boll weevil, army worm, bollworm, cutworms, and chinch bug.

On the strength of the bob-white's feeding on the boll weevil, a campaign has been waged in several Southern States for complete protection for the bird. This movement is particularly ill advised, since this bird is by no means prominent among the enemies of the boll weevil. Some 220 stomachs of bob-whites collected in cotton fields have been examined, with the result that a single boll weevil was found in one stomach. The reports of bob-white's eating large numbers of boll weevils are based on field observations, which are very liable to inaccuracy, and upon the behavior of captive birds, which has little if any value as an indication of their habits under natural conditions.

On the other hand, the food habits of the bob-white undoubtedly are beneficial and the bird should be maintained in numbers on every farm. This is not to say that all shooting should be prohibited, for the bird is very prolific. But its numbers should not be reduced below what the available nesting sites and range will support.—W. L. M.

SWALLOW-TAILED KITE.[1]

The swallow-tailed kite is not only one of the most common birds of prey in the South, but also one of the most beneficial. Its head, neck, and lower parts are white, and its back, wings, and tail, a glossy bluish black. The bird is as much at home in the air as a swift or swallow, usually feeding and drinking without alighting. Its ease and grace of movement always command admiration.

This kite preys upon beetles, wasps, cotton worms, grasshoppers, and dragonflies. It takes also frogs, lizards, and small snakes. The swallow-tailed kite seems to be entirely innocent of preying upon birds or mammals, after the fashion of so many of its raptorial relatives, and on the whole is a species worthy of preservation.—W. L. M.

TURKEY BUZZARD.[2]

Turkey buzzards (fig. 20) are familiar features of southern landscapes. On the ground they appear uncouth and awkward, but in the air show a skill, particularly in soaring, approached by few other birds. Their wonderful soaring flight has been a subject of study by a multitude of observers, and the buzzard is not only the model but also the inspiration of the American invented aeroplane. The bird is chiefly

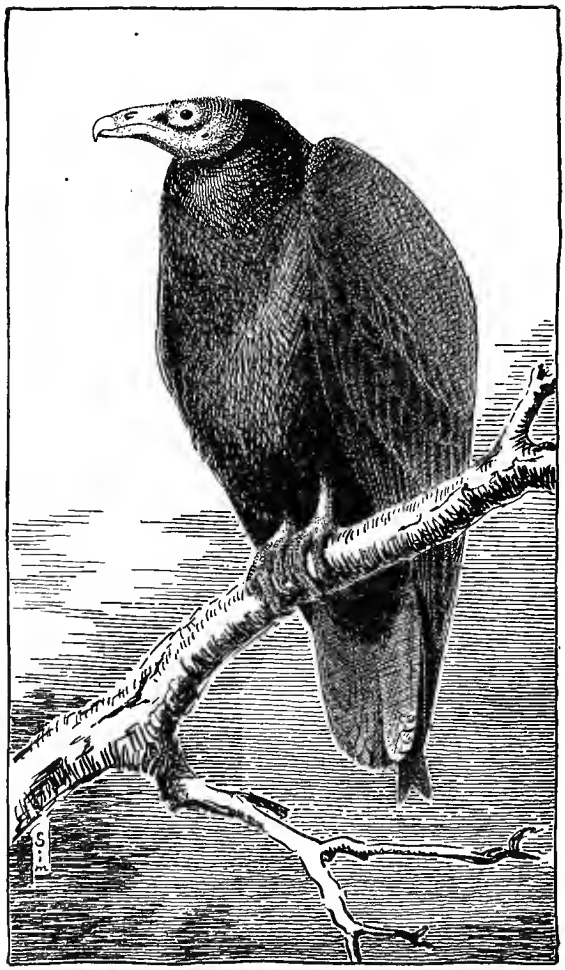
[1] *Elanoides fortificatus.*

[2] *Cathartes aura septentrionalis.*

black in color, but the naked skin of the head and neck and the base of the bill are bright red.[1]

Buzzards nest on the ground under brush piles, bushes, or palmettos, or in hollow logs or rock crevices. They roost usually on dead branches, and sometimes, especially in winter, congregate in large numbers.

All vultures specialize in feeding on carrion. While under natural conditions the number of dead animals available for them is somewhat limited, yet, where the human population is considerable and sanitary conditions not over good, there is much work for buzzards, and they fill an important place. For nearly three centuries their work has been appreciated at its full value in the South, and these birds have been scrupulously protected.



B2169-36

FIG. 20.—Turkey buzzard. Length, about 30 inches.

The turkey buzzard now is threatened with persecution in the land where heretofore it has received the most zealous protection, for the bird has been accused of spreading such diseases of live stock as hog cholera and anthrax. The charge that it spreads hog cholera has never been demonstrated, and until this is done judgment should be suspended. Its relation to anthrax has been investigated with the result that in the distribution of the disease the bird must be considered a minor agency as compared with man and various domestic and certain wild animals.

The nature of their food would indicate that buzzards have strong digestive powers. The spores of anthrax, or charbon, a virulent stock disease, have been shown by two independent investigations to be destroyed by passing through the alimentary canals of buzzards. Anthrax spores are not destroyed in the digestive tracts of other carrion-feeding animals, as the dog, cat, hog, chicken, or opossum.

[1] The black vulture (*Catharista urubu*), more abundant near the seacoast and more southern in distribution than the turkey buzzard, differs from the latter in having the head and neck black, and the under surface of the wings silvery. The flight of this vulture is more labored, and accompanied by more flapping of the wings. In general habits the two birds are alike.

It is true that buzzards may carry the germs of anthrax or other stock diseases on their plumage, feet, or bills, and thus distribute them; but all the other animals just mentioned may similarly carry disease germs on the surfaces of their bodies, as may also flies, domestic pigeons and other poultry, horses, mules, and cattle, not to mention members of the human family. In fact at the same time that steps are being taken greatly to reduce or exterminate a wild bird—the buzzard—which may possibly play a minor part in the transmission of anthrax, farmers are harboring several domestic animals that have far greater possibilities as spreaders of the disease. The fact that anthrax may be carried by flies is more than sufficient to explain the most severe epidemics.

Obviously, it is unfair to attempt to place the blame for general dissemination of stock diseases on the buzzard. Considering the multitude of ways in which these diseases may be spread, it can not be doubted that stock diseases would be as widely distributed as now if turkey buzzards were eliminated, as has been proposed. What amounts to proof of this is the fact that hog cholera at times is virulent and seriously destructive in regions where there are few or no turkey buzzards, as in certain Northern States and Canadian Provinces.

Attacks in the South by buzzards upon living farm animals indicate that there are to many buzzards there for the best economic interests. In the North, where buzzards are fewer, such attacks are believed never to occur. Reduction in the number of buzzards may be desirable, especially if accompanied by or resulting from a proper system of carrion disposal, but there is a wide gulf both in meaning and desirability between reduction in numbers and extermination.

Practically the only way to carry on a destructive campaign against the buzzard would be by shooting. Inevitably the guns would largely be in the hands of the less responsible classes of the population, and many birds other than buzzards would undoubtedly be shot. This is a powerful argument against undertaking extermination of buzzards unless it shall be definitely proved to be necessary.—W. L. M.

PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RELATING TO THE FOOD OF BIRDS.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

The English Sparrow as a Pest. (Farmers' Bulletin 493.)
Some Common Game, Aquatic, and Rapacious Birds in Relation to Man. (Farmers' Bulletin 497.)
Bird Houses and How to Build Them. (Farmers' Bulletin 609.)
Some Common Birds Useful to the Farmer. (Farmers' Bulletin 630.)
Plants Useful to Attract Birds and Protect Fruit. (Yearbook Separate 504.)
Winter Crow Roosts. (Yearbook Separate 659.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Our Grosbeaks and Their Relation to Agriculture. (Farmers' Bulletin 456.) Price 5 cents.
Food of Some Well-Known Birds of Forest, Farm, and Garden. (Farmers' Bulletin 506.) Price 5 cents.
Fifty Common Birds of Farm and Orchard. (Farmers' Bulletin 513, colored illustrations.) Price, 15 cents.
Food of the Robins and Bluebirds of the United States. (Department Bulletin 171.) Price, 5 cents.
Food Habits of the Thrushes of the United States. (Department Bulletin 280.) Price, 5 cents.
Bird Enemies of the Codling Moth. (Yearbook Separate 564.) Price, 5 cents.
Our Meadowlarks in Relation to Agriculture. (Yearbook Separate 590.) Price, 5 cents.
Relation of Birds to Grain Aphides. (Yearbook Separate 601.) Price, 5 cents.
Food Habits of the Grosbeaks. (Biological Survey Bulletin 32.) Price, 25 cents.
Food of the Woodpeckers of the United States. (Biological Survey Bulletin 37.) Price, 35 cents.
Birds of Arkansas. (Biological Survey Bulletin 38.) Price, 25 cents.
Woodpeckers in Relation to Trees and Wood Products. (Biological Survey Bulletin 39.) Price, 30 cents.
Index to Papers Relating to the Food of Birds, by Members of the Biological Survey, in Publications of the Department of Agriculture, 1885–1911. (Biological Survey Bulletin 43.) Price, 10 cents.
Food of Our More Important Flycatchers. (Biological Survey Bulletin 44.) Price, 20 cents.
Hawks and Owls from the Standpoint of the Farmer. (Biological Survey Circular 61.) Price, 5 cents.
Destruction of the Cotton Boll Weevil by Birds in Winter. (Biological Survey Circular 64.) Price, 5 cents.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1916

U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 630

SOME COMMON BIRDS USEFUL *to the* FARMER

FROM a purely practical point of view the most important of the relations of native birds to man are the economic. The esthetic value of birds is great—greater, indeed, than that of any other group of animals; and that this is a real and especially treasured value is not to be denied. But it is in their relation to insect and other enemies of crops that birds are most directly associated with the welfare of mankind, and their value in this particular should be made as widely known as possible.

This bulletin is one of a series designed to assist in doing this. Not all birds are beneficial, and all facts tending to show in which class each species belongs will be set forth. The useful kinds far outnumber the injurious, however, and so great is their value as insect destroyers in the United States that to them may be given the credit of being one of the greatest controlling factors in limiting the development of insect pests and in preventing many disastrous outbreaks.

In the following pages are discussed the habitat, food habits, and relation to agriculture of more than 50 species of birds common to farming sections.

Washington, D. C. Issued February 13, 1915; revised May, 1923

SOME COMMON BIRDS USEFUL TO THE FARMER.[1]

By F. E. L. Beal, Late *Assistant Biologist, Division of Food Habits Research, Bureau of Biological Survey.*

CONTENTS.

WHETHER a bird is beneficial or injurious depends almost entirely upon what it eats. In the case of species which are very abundant, or which feed to some extent on the crops of the farmer, the question of their average diet becomes one of supreme importance, and only by stomach examinations can it be satisfactorily answered. Field observations are at best but fragmentary and inconclusive and lead to no final results. Birds are often accused of eating this or that product of cultivation, when an examination of the stomachs shows the accusation to be unfounded. Accordingly, the Biological Survey has conducted for some years a systematic investigation of the food of those species which are most common about the farm and garden.

Within certain limits birds eat the kind of food that is most accessible, especially when their natural food is scarce or wanting. Thus they sometimes injure the crops of the farmer who has unintentionally destroyed their natural food in his improvement of swamp or pasture. Most of the damage done by birds and complained of by farmers and fruit growers arises from this very cause. The berry-producing shrubs and seed-bearing weeds have been cleared away, and the birds have no recourse but to attack the cultivated grain or fruit which has replaced their natural food supply. The great majority of land birds subsist upon insects during the period of nesting and molting, and also feed their young upon them during the first few weeks. Many species live almost entirely upon insects, taking vegetable food only when other subsistence fails. It is thus

[1] This bulletin is largely a revision of Farmers' Bulletin 54, by Prof. F. E. L. Beal. The parts relating to the crow and blue jay were contributed by E. R. Kalmbach, assistant biologist, and the discussion of the nighthawk and bobwhite by W. L. McAtee, in charge, Food Habits Research. Professor Beal, author of the remainder of the bulletin, died October 1, 1916.

evident that in the course of a year birds destroy an incalculable number of insects, and it is difficult to overestimate the value of their services in restraining the great tide of insect life.

In winter, in the northern part of the country, insects become scarce or entirely disappear. Many species of birds, however, remain during the cold season and are able to maintain life by eating vegetable food, as the seeds of weeds. Here again is another useful function of birds in destroying these weed seeds and thereby lessening the growth of the next year.

In the following pages are discussed the food habits of more than 50 birds belonging to 12 families. Many are eastern forms which are represented in the West by slightly different species or subspecies, but unless the food habits differ they are not separately described. In some cases specific percentages of food are given, but for the most part the statements are made without direct reference to the data on which they are based.[2]

THE BLUEBIRDS.

The eastern bluebird[3] (fig. 1), one of the most familiar and welcome of our feathered visitors, is a common inhabitant of all the States east of the Rocky Mountains from the Gulf of Mexico to southern Canada. In the Mississippi valley it winters as far north as southern Illinois, and in the East as far as Pennsylvania. It is one of the earliest northern migrants, and everywhere is hailed as a harbinger of spring. Very domestic in habits, it frequents orchards and gardens, and builds its nests in cavities of trees, crannies in farm buildings, or boxes provided for its use.

FIG. 1.—Bluebird. Length, about 6½ inches.

The bluebird has not been accused, so far as known, of stealing fruit or of preying upon crops. An examination of 855 stomachs showed that 68 per cent of the food consists of insects and their allies, while the other 32 per cent is made up of various vegetable substances, found mostly in stomachs taken in winter. Beetles constitute 21 per cent of the whole food, grasshoppers 22, caterpillars 10, and various other insects 9, while a number of spiders and myriapods, about 6 per cent, comprise the remainder of the animal diet. All these are more or less harmful, except a few predacious beetles, which amount to 9 per cent. In view of the large consumption of grasshoppers and caterpillars, we may at least condone this offense, if such it may be called. The destruction of grasshoppers is very noticeable in August and September, when these insects make up about 53 per cent of the diet.

It is evident that in the selection of its food the bluebird is governed more by abundance than by choice. Predacious beetles are eaten in spring, as they are among the first insects to appear; but in early summer caterpillars form an important part of the diet, and these are later replaced by grasshoppers. Beetles are eaten at all times, except when grasshoppers are more easily obtained.

So far as its vegetable food is concerned the bluebird is positively harmless. The only trace of any useful product in the stomachs consisted of a few black-

[2] For a list of bulletins describing the food habits of wild birds and groups of birds, see page 31.

[3] *Sialia sialis.*

berry seeds, and even these probably belonged to wild rather than cultivated varieties. Following is a list of the various seeds which were found; Blackberry, chokeberry, juniperberry, pokeberry, partridgeberry, greenbrier, Virginia creeper, bittersweet, holly, strawberry bush, false spikenard, wild sarsaparilla, sumac (several species), rose haws, sorrel, ragweed, grass, and asparagus. This list shows how little the bluebird depends upon the farm or garden to supply its needs and how easily, by encouraging the growth of some of these plants, many of which are highly ornamental, the bird may be induced to make its home on the premises.

Two species of bluebirds inhabit the Western States—the mountain bluebird [4] and the western bluebird.[5] In their food habits they are even more to be commended than their eastern relative. Their insect food is obtainable at all times of the year, and the general diet varies only in the fall, when some fruit, principally elderberries, is eaten, though an occasional blackberry or grape is also relished. In an examination of 217 stomachs of the western bluebird, animal matter (insects and spiders) was found to the extent of 82 per cent and vegetable matter to the extent of 18 per cent. The bulk of the former consists of bugs, grasshoppers, and caterpillars. Grasshoppers, when they can be obtained, are eaten freely during the whole season. Caterpillars also are a favorite food and are eaten during every month of the year; March is the month of greatest consumption, with 50 per cent, and the average for the year is 20 per cent. Two stomachs taken in January contained 64 and 50 per cent, respectively, of caterpillars. Beetles also are eaten and comprise mostly harmful species.

The vegetable matter consists of weed seeds and small fruits. In December a few grapes are eaten, but elderberries are the favorites whenever they can be found. It is only when these are in their greatest abundance that vegetable exceeds animal food.

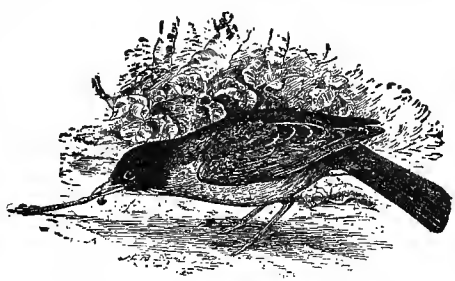


FIG. 2.—Robin. Length, about 10 inches.

THE ROBINS.

The robin [6] (fig. 2), in many parts of the country one of the most cherished of our birds, is found throughout the States east of the Great Plains, and is represented farther west and south by slightly different subspecies.[7, 8] It breeds far north through Canada, and is found even in Alaska. Although the great bulk of the species leaves the Northern States in winter, a few individuals remain in sheltered swamps, where wild berries furnish abundant food. The robin is an omnivorous feeder and its food habits have sometimes caused apprehension to the fruit grower, for it is fond of cherries and other small fruits, particularly the earlier varieties. For this reason many complaints have been lodged against robins, and it has been necessary to permit the killing of the birds in some fruit-growing regions.

Examinations of 1,236 stomachs show that 42 per cent of its food is animal matter, principally insects, while the remainder is made up largely of small fruits or berries. Over 16 per cent consists of beetles, about one-third of which are useful ground beetles, taken mostly in spring and fall when other insects are scarce. Grasshoppers make up about 5 per cent of the whole food, but in August they comprise 17 per cent. Caterpillars form about 9 per cent, while the rest of the animal food, about 11 per cent, is made up of various insects, with a few spiders, snails, and angleworms. All the grasshoppers, caterpillars, and bugs, with a large portion of the beetles, are injurious, and it is safe to say that noxious insects comprise more than one-third of the robin's food.

Vegetable food forms 58 per cent of the stomach contents, over 42 per cent being wild fruits and only a little more than 8 per cent being possibly cultivated varieties. Cultivated fruit amounting to about 25 per cent was found in

---

[4] *Sialia currucoides.*
[5] *Sialia mexicana* subspecies.
[6] *Planesticus migratorius.*
[7] *Planesticus migratorius propinquus.*
[8] *Planesticus migratorius achrusterus.*

nighthawk, crow, red-headed woodpecker, and the yellow-headed and crow blackbirds. Forty-three kinds of birds feed upon the army worms, pests destructive to corn and all small grains. Eighty-eight southeastern species devour cutworms, which are often the despair of grain growers and gardeners. Largest numbers of cutworms have been found in stomachs of the prairie chicken, bob-white, wood duck, woodcock, sparrow hawk, yellow-billed cuckoo, nighthawk, red-headed woodpecker, crow blackbird, meadowlark, English sparrow, cardinal, and robin.

No insect enemy of corn and wheat is more destructive than the chinch bug; when it is numerous, fields are blasted as if by fire. It is often said that the chinch bug has few natural enemies, but the work of birds, 24 species of which feed upon chinch bugs, should not be overlooked. Over 100 of these pests have been found in single stomachs of the bob-white and meadowlark, and over 200 in one of a brown thrasher. Other birds consuming chinch bugs in considerable numbers are the flicker, the crow, the barn, tree, and cliff swallows, and the house wren. The southern corn leaf beetle, a pest that has come to be of considerable importance in the past few years, is devoured by 22 kinds of birds. Those taking the largest numbers are the mockingbird, the Bewick wren, and the house wren.

Among other corn insects may be mentioned the southern corn rootworm (or spotted cucumber beetle), eaten by 26 species of southeastern birds; beetles of a group including the cane root borer and the carrot beetle, devoured by 18 species; and the brown fruit-chafer, by 21. The last-named beetle feeds also on apples, pears, and peaches, as does a related insect known as the southern fig eater. Fourteen species of birds prey upon the fig eater, the crow most extensively.

The insect pests of clover and other forage crops in the Southeastern States also are sought by many birds. Perhaps more damage is done in the aggregate by leafhoppers than by other enemies of these crops. Exactly 100 species of southeastern birds are now known to feed on these small but exceedingly numerous insect pests. Largest numbers of leafhoppers have been found in stomachs of the nighthawk, chimney swift, barn swallow, and yellow-headed blackbird. Clover is attacked by a number of insect pests, including the imbricated-snout beetle and the various clover weevils. The first named is eaten by 20 kinds of birds, of which the crow, crow blackbird, and catbird seem most voracious. The common or large clover leaf weevil is the prey of 25 species of birds. The nighthawk, crow, red-headed woodpecker, purple martin, and crow blackbird have the best records for destruction of adults, and the Savannah and vesper sparrows of the larvæ. The smaller clover weevils are eaten by 74 species of southeastern birds. Largest numbers of these weevils

have been found in the stomachs of the robin, hermit thrush, tufted titmouse, and white-crowned sparrow, and of the following four species of birds, some representative of each of which had consumed at one meal more than 50 individuals: Nighthawk, chimney swift, tree swallow, and purple martin.

It is perhaps worth while to mention the bird predators upon certain insect enemies of truck crops. The destructive little cucumber flea beetle and its congeners, which feed on potato, tomato, sweet potato, eggplant, and tobacco, are preyed upon by 19 species of southeastern birds. The sweet potato flea beetle and its allies have 28 known bird enemies in this section; the grapevine leaf beetle, 21; the grape flea beetle, 23; and the bean leaf beetle, 19. The rice weevil has been found in stomachs of 20 species of birds, the notorious Colorado potato beetle in 26, and the periodical cicada, or 17-year locust, in 33. Pests of considerable importance in the South whose bird enemies it is well to mention are the horseflies. These are preyed upon by 49 species of southeastern birds. The stomach of one killdeer contained 40 horsefly larvæ.

The foregoing demonstrates that many of the worst pests of southern agriculture have enemies in the bird world. The insects which have been considered chiefly are those destructive to grain and field crops; but among forest insects, fruit insects, and all the host that prey upon truck and garden crops, few can be mentioned that do not have important bird enemies. Farmers should recognize their friends and do all in their power to protect them.

HOUSE WREN.[1]

The house wren (fig. 2), a fussy, flighty, and fidgety little midget, frequents the vicinity of barns and gardens and particularly old orchards where the trees are partially decayed. Never for a moment at rest while there is a ray of daylight, it would seem that his small body must soon be worn out by his incessant activity. His voice, as tireless as his wings, is heard from morning until night about the garden and orchard where he seeks his daily food, and while not very melodious it is cheerful and suggestive of life and activity.

Probably no bird displays greater eccentricity in the selection of a nesting site than the house wren. A hollow branch or a knothole in a post or stump are his more prosaic choices. When more esthetically inclined he affects old boots or hats hung up to scare the robin from the cherries, or takes an old copper pot or tomato can lying on the roof of a back shed; or, if the gardener hangs his coat on the fence when warm weather begins and forgets it for a few days, he may find when he returns that an enterprising wren has preempted one of the pockets and has his domestic affairs under full headway. The empty skull of a horse or cow when set on a post by the frolicsome schoolboy makes an excellent nesting place for the wren, who is never troubled by the ghost of the former occupant. Whatever place he chooses, his ambition is to occupy the whole of it. This he accomplishes by carrying in sticks, straws, and other rubbish until all available space is filled, only just room enough being left for the mother bird and her eggs.

[1] *Troglodytes aëdon.*

Perhaps the most important and interesting insect found was the black olive scale, which occurred in 24 stomachs and amounted to a little more than 18 per cent of the food. In addition, a number of the stomachs were more or less filled with another scale, which was not further identified. A number of small snout beetles (weevils) were eaten and some small caterpillars; there were also the remains of a spider.

The vegetable food of the species seemed to consist mostly of seeds, but they were so broken up as to defy recognition. A little fruit pulp and a little mast were also found.

Among the stomachs of the bush tits examined were those of one brood of eight nestlings about 10 days old. The vegetable matter in these stomachs was only three-fourths of 1 per cent and consisted of one seed and some rubbish. The animal matter was made up of beetles, wasps, bugs, caterpillars and pupæ, and spiders. The greatest interest lies in the fact that every one of these stomachs contained pupæ of the codling moth, on an average of over five to each. The oak tree in which these birds were found was in a belt of timber near a neglected orchard which the parent birds used as a foraging ground, and they did their best to remedy the neglect of the owner. As feeding and digestion in the case of nestling birds is almost continuous during the hours of daylight, the above record would be several times repeated during a day's feeding. There were probably not less than a dozen nests of the bush tit along the border of this orchard, and these birds must have exerted a great restrictive influence upon the increase of the codling moth, as well as of other insects in that vicinity.

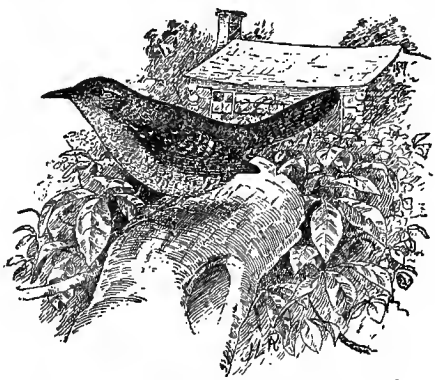


FIG. 4.—House wren. Length, about 4¾ inches.

THE WRENS.

The diminutive house wren[12] (fig. 4) frequents barns and gardens, and particularly old orchards in which the trees are partially decayed. He makes his nest in a hollow where perhaps a woodpecker had a domicile the year before, but he is a pugnacious character, and if he happens to fancy one of the boxes put up for bluebirds, he does not hesitate to take it. He is usually not slow to avail himself of boxes, gourds, tin cans, or empty jars placed for his accommodation.

In food habits the house wren is entirely beneficial. He may be said to live upon animal food alone, for an examination of 88 stomachs showed that 98 per cent of the contents was made up of insects or their allies, and only 2 per cent was vegetable food, including bits of grass and similar matter, evidently taken by accident with the insects. Half of this food consisted of grasshoppers and beetles; the remainder of caterpillars, bugs, and spiders. As the wren is a prolific breeder, frequently rearing in a season from 12 to 16 young, a family of these birds must cause considerable reduction in the number of insects in a garden. Wrens are industrious foragers, searching every tree, shrub, and vine for caterpillars, and examining every post and rail of the fence and every cranny in the wall for insects or spiders.

The house wren is only one of a numerous group of small birds of similar habits. There are within the limits of the United States 28 species and subspecies of wrens, occupying more or less completely the whole country from the Atlantic to the Pacific. With the exception of the marsh wrens,[13] they all appear to prefer some cosy nook for a nesting site, and, as it happens, the farm buildings afford just the place desired. This has led several of the wrens to seek out the habitations of man, and he is benefited by their destruction of noxious insects. Wrens have rarely been accused of harm, and their presence should be encouraged about every farm, ranch, village, or suburban residence.

---

[12] *Troglodytes ædon.* [13] *Telmatodytes palustris* and *Cistothorus stellaris.*

BROWN THRASHER.

The brown thrasher[15] (fig. 5) breeds throughout the United States east of the Great Plains, and winters in the South Atlantic and Gulf States. It visits the garden or orchard, its nest, however, being in dense shrubbery or groves. The thrasher's favorite time for singing is in early morning, when, perched on the top of a bush or tree, it gives an exhibition of vocal powers which would do credit to the mockingbird. Indeed, in the South, where the latter bird is abundant, the thrasher is known as the sandy mocker.

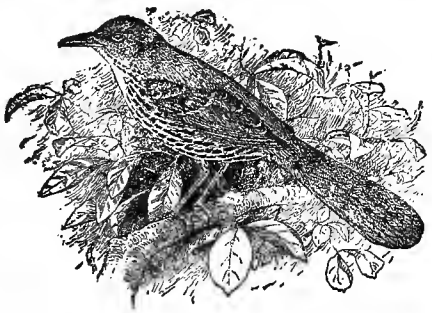


FIG. 5.—Brown thrasher. Length, about 11 inches.

The food of the brown thrasher consists of both fruit and insects. An examination of 636 stomachs showed 59 per cent of vegetable and 41 per cent of animal food, practically all insects, and mostly taken in spring before fruit was ripe. Half the insects were beetles and the remainder chiefly grasshoppers, caterpillars, bugs, and spiders. A few predacious beetles were eaten, but on the whole the work of the species as an insect destroyer may be considered beneficial.

Eight per cent of its food is made up of fruits like raspberries and currants which are or may be cultivated, but the raspberries at least are as likely to belong to wild as to cultivated varieties. Grain, made up mostly of scattered kernels of oats and corn, is merely a trifle, amounting to only 3 per cent. Though some of the corn may be taken from newly planted fields, it is amply paid for by the destruction of May beetles which are eaten at the same time. The rest of the food consists of wild fruit or seeds. Taken all in all, the brown thrasher is a useful bird, and probably does as good work in its secluded retreats as it would about the garden, for the swamps and groves are no doubt the breeding grounds of many insects that migrate thence to attack the crops of the farmer.

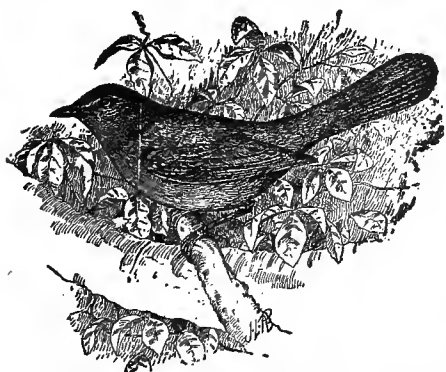


FIG. 6.—Catbird. Length, about 9 inches.

CATBIRD.

The catbird[16] (fig. 6), like the thrasher, is a lover of thickets and delights to make its home in a tangle of wild grapevines, greenbriers, and shrubs, where it is safe from attack and can find its favorite food in abundance. It is found throughout the United States west to the Rocky Mountains, and extends also from Washington, Idaho, and Utah northward into the Provinces of Canada. It winters in the Southern States, Cuba, Mexico, and Central America.

Reports from the Mississippi Valley indicate that the catbird is sometimes a serious annoyance to fruit growers. The reason for such reports may possibly be found in the fact that on the prairies fruit-bearing shrubs, which afford so large a part of this bird's food, are conspicuously absent. With the settlement of this region comes an extensive planting of orchards, vineyards, and small-fruit gardens, which furnish shelter and nesting sites for the catbird as well as for other species. There is in consequence a large increase in the numbers of the birds, but no corresponding gain in the supply of native fruits upon

[15] *Toxostoma rufum.*

[16] *Dumetella carolinensis.*

which they were accustomed to feed. Under these circumstances what is more natural than for the birds to turn to cultivated fruit for their food. The remedy is obvious: Cultivated fruits can be protected by the simple expedient of planting the wild species which are preferred by the birds. Some experiments with catbirds in captivity show that the Russian mulberry is preferred to any cultivated fruit.

The stomachs of 645 catbirds were examined and found to contain 44 per cent of animal (insect) and 56 per cent of vegetable food. Ants, beetles, caterpillars, and grasshoppers constitute three-fourths of the animal food, the remainder being made up of bugs, miscellaneous insects, and spiders. One-third of the vegetable food consists of cultivated fruits, or those which may be cultivated, as strawberries, raspberries, and blackberries; but while we debit the bird with the whole of this, it is probable—and in the eastern and well-wooded part of the country almost certain—that a large part is obtained from wild vines. The rest of the vegetable matter is mostly wild fruit, as cherries, dogwood, sour gum, elderberries, greenbrier, spiceberries, black alder, sumac, and poison ivy. Although the catbird sometimes does considerable harm by destroying small fruit, it can not on the whole be considered injurious. On the contrary, in most parts of the country it does far more good than harm.

FIG. 7.—Barn swallow. Length, about 7 inches.

THE SWALLOWS.

Seven common species of swallows are found within the limits of the United States, four of which have abandoned to some extent their primitive nesting habits and have attached themselves to the abodes of man.

In the eastern part of the country the barn swallow[17] (fig. 7) now builds exclusively under roofs, having entirely abandoned the rock caves and cliffs in which it formerly nested. More recently the cliff swallow[18] has found a better nesting site under the eaves of buildings than was afforded by the overhanging cliffs of earth or stone which it once used and to which it still resorts occasionally in the East and habitually in the unsettled West. The martin[19] and the white-bellied, or tree, swallow[20] nest either in houses supplied for the purpose, in abandoned nests of woodpeckers, or in natural crannies in rocks. The northern violet-green swallow,[21] the rough-winged swallow,[22] and the bank swallow[23] still live in practically such places as their ancestors chose.

Field observation convinces an ordinarily attentive person that the food of swallows must consist of the smaller insects captured in mid-air or picked from the tops of tall grass or weeds. This observation is borne out by an examination of stomachs, which shows that the food is made up of many small species of beetles which are much on the wing; many species of flies, together with large quantities of flying ants; and a few insects of similar kinds. Most of these are either injurious or annoying, and the numbers destroyed by swallows are not only beyond calculation but almost beyond imagination.

Unlike many other groups of birds, the six species of swallows found in the Eastern States extend in a practically unchanged form across the continent, where they are reinforced by the northern, or Pacific-coast, violet-green swallow.

It is a mistake to tear down from the eaves of a barn the nests of a colony of cliff swallows, for so far from disfiguring a building they make a picturesque addition to it, and the presence of swallows should be encouraged by every

[17] *Hirundo erythrogastra.*
[18] *Petrochelidon lunifrons.*
[19] *Progne subis.*
[20] *Iridoprocne bicolor.*
[21] *Tachycineta thalassina.*
[22] *Stelgidopteryx serripennis.*
[23] *Riparia riparia.*

device. It is said that cliff and barn swallows may be induced to build their nests in a particular locality, otherwise suitable, by providing a quantity of mud to be used by them as mortar. Barn swallows may also be encouraged by cutting a small hole in the gable of the barn, while martins and white-bellied swallows will be grateful for boxes like those for the bluebird, but placed in a higher situation.

TOWHEE.

The towhee, chewink, or ground robin[24] (fig. 8), as it is variously known, inhabits nearly the whole of the United States east of the Great Plains. It breeds from the Middle States northward and winters in the southern half of the country. Naturally associated with the catbird and brown thrasher, it lives in much the same places, though it is more given to haunting hedgerows along roads and fences. After snow has disappeared in early spring an investigation of the rustling so often heard among the leaves near a fence or in a thicket will frequently disclose a towhee hard at work scratching for his dinner after the manner of a hen; and in these places and along the sunny border of woods old leaves will be found overturned where the bird has been searching for hibernating beetles and larvæ. The good which the towhee does in this way can hardly be overestimated, since the death of a single insect at this time, before it has had an opportunity to deposit its eggs, is equivalent to the destruction of a host later in the year. The towhee has also been credited with visiting potato fields and feeding upon the potato beetle. Its vegetable food consists of seeds and small wild fruits, but no complaint on this score is known to have been made. So far as observation goes, the bird never touches either cultivated fruit or grain; in fact, it is too shy and retiring even to stay about gardens for any length of time.

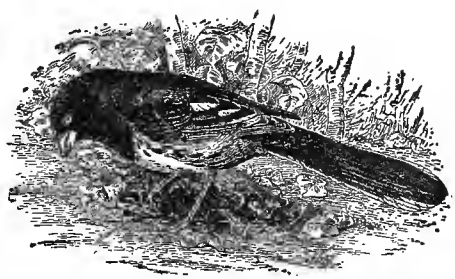


FIG. 8.—Towhee. Length, about 8 inches.

THE SPARROWS.[25]

Sparrows are not obtrusive birds, either in plumage, song, or action. There are some 40 species, with nearly as many subspecies, in North America. Not more than half a dozen forms are generally known in any one locality. All the species are more or less migratory, but so widely are they distributed that there is probably no part of the country where some can not be found throughout the year.

While sparrows are noted seed eaters, they do not by any means confine themselves to a vegetable diet. During the summer, and especially in the breeding season, they eat many insects and feed their young largely upon the same food. Examination of stomachs of three species—the song sparrow[26] (fig. 9), chipping sparrow,[27] and field sparrow[28] (fig. 10)—shows that about one third of the food consists of insects, comprising many injurious beetles, as spout beetles or weevils, and leaf beetles. Many grasshoppers are eaten. In the case of the chipping sparrow these insects form one-eighth of the food. Grasshoppers would seem to be rather large morsels, but the bird probably confines itself to the smaller species; indeed, the greatest amount (over 36 per cent) is eaten in June, when the larger species are still young and the smaller

[24] *Pipilo erythrophthalmus.*

[25] The sparrows here mentioned are all native species. A full account of the English, or house, sparrow (*Passer domesticus*), including its introduction, habits, and depredations, was published in Bull. No. 1 of the Division of Ornithology in 1889. For information in regard to combating the English sparrow, see Farmers' Bulletin 493, The English Sparrow as a Pest, by Ned Dearborn, revised, 1917.

[26] *Melospiza melodia.*

[27] *Spizella passerina.*

[28] *Spizella pusilla.*

most numerous. Besides the insects already mentioned, many wasps and bugs are taken. Predacious and parasitic hymenopterous insects and predacious beetles, all useful, are eaten only to a slight extent, so that as a whole the insect diet of the native sparrows may be considered beneficial. There are several records of potato-bug larvæ eaten by chipping sparrows.

FIG. 9.—Song sparrow. Length, about 6½ inches.

Their vegetable food is limited almost exclusively to hard seeds. This might seem to indicate that the birds feed to some extent upon grain, but the stomachs examined show only one kind, oats, and but little of that. The great bulk of the food is made up of grass and weed seeds, which form almost the entire diet during winter, and the amount consumed is immense.

In the agricultural region of the upper Mississippi Valley, by roadsides, on borders of cultivated fields, or in abandoned fields, wherever they can obtain a foothold, masses of rank weeds spring up and often form almost impenetrable thickets which afford food and shelter for immense numbers of birds and enable them to withstand great cold and the most terrible blizzards. A person visiting one of these weed patches on a sunny morning in January, when the thermometer is 20° or more below zero, will be struck with the life and animation of the busy little inhabitants. Instead of sitting forlorn and half frozen, they may be seen flitting from branch to branch, twittering and fluttering, and showing every evidence of enjoyment and perfect comfort. If one of them is captured it will be found in excellent condition; in fact, a veritable ball of fat.

The snowbird[29] and tree sparrow[30] are perhaps the most numerous of all the sparrows. Examination of many stomachs shows that in winter the tree sparrow feeds entirely upon seeds of weeds. Probably each bird consumes about one-fourth of an ounce a day. In an article contributed in 1881 to the New York Tribune the writer estimated the amount of weed seed annually destroyed by these birds in Iowa. On the basis of one-fourth of an ounce of seed eaten daily by each bird, and an average of 10 birds to each square mile, remaining in their winter range 200 days, there would be a total of 1,750,000 pounds, or 875 tons of weed seed consumed in a single season by this one species. Large as are these figures, they unquestionably fall far short of the reality. The estimate of 10 birds to a square mile is very conservative, for in Massachusetts, where the food supply is less than in the Western States, the tree sparrow is even more abundant than this in winter. The writer has known places in Iowa where several thousand tree sparrows could be seen within the space of a few acres. This estimate, moreover, is for a single species, while, as a matter of fact, there are at least half a dozen birds (not all sparrows) that habitually feed during winter on these seeds. Farther south the tree sparrow is replaced in winter by the white-throated sparrow,[31] the white-crowned sparrow,[32] the fox

FIG. 10.—Field sparrow. Length, about 5½ inches.

[29] *Junco hyemalis.*
[30] *Spizella monticola.*
[31] *Zonotrichia albicollis.*
[32] *Zonotrichia leucophrys.*

sparrow,[33] the song sparrow, the field sparrow, and several others; so that all over the land a vast number of these seed eaters are at work during the colder months reducing next year's crop of worse than useless plants.

HOUSE FINCH.

Of all the sparrow groups, there is probably no member, unless it be the exotic form known as the English sparrow,[34] that has by reason of its food habits called down so many maledictions upon its head as the house finch,[35] red head, or linnet, as it is variously called. This bird, like the other members of its family, is by nature a seed eater, and before the beginning of fruit raising in California probably subsisted upon the seeds of weeds, with an occasional taste of some wild berry. Now, however, when orchards have extended throughout the length and breadth of the State and every month from May to December sees some ripening fruit, the linnets take their share. As their number is legion, the sum total of the fruit that they destroy is more than the fruit raiser can well spare. As the bird has a stout beak, it has no difficulty in breaking the skin of the hardest fruit and feasting upon the pulp, thereby spoiling the fruit and giving weaker-billed birds a chance to sample and acquire a taste for what they might not otherwise have molested. Complaints against this bird have been many and loud, more especially in the years when fruit crops first came to be an important factor in the prosperity of the Pacific coast. At that time the various fruits afforded the linnets a new and easily obtained food, while cultivation had reduced their formerly abundant supply of weed seed. When the early fruit growers saw their expected golden harvest suddenly snatched away or at least much reduced in value by the little marauders, it is no wonder that they were exasperated and wished to destroy the authors of the mischief.

In order to test the matter thoroughly and ascertain whether these birds ate any other kind of food that might to some extent offset the damage inflicted upon the fruit, the horticulturists and ornithologists of California were requested to secure a number of the stomachs of these birds and send them to the Biological Survey. An agent was also sent to the fruit-raising sections, who watched the birds in the orchards and collected a number of them. In this way 1,206 stomachs were obtained and carefully examined, and the result shows that animal food (insects) constituted 2.44 per cent and vegetable food 97.56 per cent of the stomach contents, not counting gravel.

So small a proportion of animal food can not, of course, mean a great destruction of insects. As these stomachs were collected in every month, with the greater number taken during the summer, it is evident that whatever good one may expect from the linnet must not be looked for in this direction. Unlike most of the sparrow family, the linnet does not feed its young upon insects to any great extent. The contents of the stomachs of a number of nestlings were carefully examined, and the only animal food was found to consist of wooly plant lice. These also constituted the great bulk of the animal food eaten by adults.

The vegetable food of the species consists of three principal items—grain, fruit, and weed seeds. Grain amounts to less than 1½ per cent in August, which is the month of greatest consumption, and the average for the year is a trifle more than one-fourth of 1 per cent. Fruit attains its maximum in September, when it amounts to 27 per cent of the whole food, but the average for the year is only 10 per cent. The seeds of weeds constitute the bulk of the diet of the linnet, and in August, the month of least consumption, amount to about 64 per cent of the food. The average for the year is 86 per cent.

From the foregoing it is evident that whatever the linnet's sins may be, grain eating is not one of them. In view of the great complaint made against its fruit-eating habits, the small quantity found in the stomachs taken is somewhat of a surprise. But it must be remembered that the stomach contents do not tell the whole story. When a bird takes a single peck from a cherry or an apricot, it spoils the whole fruit, and in this way may ruin half a dozen in taking a single meal. It is safe to say that the fruit pulp found in the stomach does not represent more than one-fifth of what is actually destroyed. That the linnets are persistent and voracious eaters of early fruits, especially cherries and apricots, every fruit raiser in California will bear testimony. That the

[33] *Passerella iliaca.* [34] *Passer domesticus.*
[35] *Carpodacus mexicanus frontalis.*

damage is often serious no one will deny. It is noticeable, however, that the earliest varieties are the ones most affected; also, that in large orchards the damage is not perceptible, while in small plantations the whole crop is frequently destroyed.

THE GRACKLES.

The crow blackbird or grackle[36] (fig. 11) in one or more of its subspecies is a familiar object in all the States east of the Rocky Mountains. Throughout the year it is resident as far north as southern Illinois, and in summer extends its range into the Canadian Provinces. In the Mississippi Valley it is one of the most abundant of birds, preferring to nest in the artificial groves and windbreaks near farms instead of in the natural "timber" which it formerly used. It breeds also in parks and near buildings, often in considerable colonies. Farther east, in New England, it is only locally abundant, though frequently seen in migration. In the latter days of August and throughout September it is found in immense numbers before moving southward.

The grackle is accused of many sins, such as stealing grain and fruit and robbing the nests of other birds. An examination of 2,346 stomachs shows that nearly one-third of its food consists of insects, most of which are injurious. The bird also eats a few snails, crawfishes, salamanders, small fish, and occasionally a mouse. The stomach contents do not indicate that it robs other birds' nests to any great extent, as remains of birds and birds' eggs amount to less than half of 1 per cent.

FIG. 11.—Purple grackle. Length, about 12 inches.

It is on account of its vegetable food that the grackle most deserves condemnation. Grain is eaten during the whole year, and only for a short time in summer is other food attractive enough to induce the bird to alter its diet. The grain taken in winter and spring probably consists of waste kernels from stubble. The stomachs do not indicate that the bird pulls sprouting grain; but the wheat eaten in July and August and the corn eaten in the fall are probably from fields of standing grain. The total amount of grain consumed during the year constitutes 45 per cent of the food, but it is safe to say that at least half is waste grain and consequently of no value. Although the crow blackbird eats a few cherries and blackberries in their season, and in the fall some wild fruit, it apparently does no damage in this way.

Large flocks of grackles no doubt do considerable injury to grain crops, and there seems to be no remedy, except the destruction of the birds, which is in itself expensive. During the breeding season, however, the species does much good by eating insects and by feeding them to its young, which are reared almost entirely upon this food. The bird does the greatest amount of good in spring, when it follows the plow in search of large grubworms, of which it is so fond that it sometimes literally crams its stomach full of them.

BREWER BLACKBIRD.

The Brewer blackbird[37] takes the place in the Western States of the grackle, or crow blackbird, which lives in the Mississippi Valley and farther east and is very similar in appearance and habits. It breeds east to the Great Plains and north into Canada, and winters over most of its breeding range in the United States and south to Guatemala. At home in fields, meadows, and orchards, and about ranch buildings and cultivated lands generally, it nests in bushes and weeds, sometimes in trees, and is very gregarious, especially about barnyards and corrals. The bird feeds freely in stockyards and in cultivated fields, and when fruit is ripe does not hesitate to take a share. During the cherry season

[36] *Quiscalus quiscula.* [37] *Euphagus cyanocephalus.*

in California the birds are much in the orchards. In one case they were observed feeding on cherries, but when a neighboring fruit grower began to plow his orchard almost every blackbird in the vicinity was upon the newly opened ground close after the plowman's heels in its eagerness to secure the insects turned up.

The laboratory investigation of this bird's food covered 312 stomachs, collected in every month and representing especially the fruit and grain sections of southern California. The animal portion of the food was 32 per cent and the vegetable 68 per cent.

Caterpillars and their pupæ amounted to 12 per cent of the whole food and were eaten every month. They include many of those pests known as cutworms. The cotton-boll worm, or corn-ear worm, was identified in at least 10 stomachs, and in 11 were found pupæ of the codling moth. The animal food also included other insects, and spiders, sow bugs, snails, and eggshells.

The vegetable food may be divided into fruit, grain, and weed seeds. Fruit was eaten in May, June, and July, not a trace appearing in any other month, and was composed of cherries, or what was thought to be such, strawberries, blackberries or raspberries, and fruit pulp or skins not further identified. However, the amount, a little more than 4 per cent for the year, was too small to make a bad showing, and if the bird does no greater harm than is involved in its fruit eating it is well worth protecting. Grain amounts to 54 per cent of the yearly food and forms a considerable percentage in each month; oats are the favorite and were the sole contents of 14 stomachs, and wheat of 2, but no stomach was completely filled with any other grain. Weed seeds, eaten in every month to the extent of 9 per cent of the food, were found in rather small quantities and irregularly, and appear to have been merely a makeshift.

Stomachs of nestlings, varying in age from 24 hours to some that were nearly fledged, were found to contain 89 per cent animal to 11 per cent vegetable matter. The largest items in the former were caterpillars, grasshoppers, and spiders. In the latter the largest items were fruit, probably cherries; grain, mostly oats; and rubbish.

FIG. 12.—Baltimore oriole. Length, about 7½ inches.

BALTIMORE ORIOLE.

Brilliancy of plumage, sweetness of song, and food habits to which no exception can be taken are some of the striking characteristics of the Baltimore oriole[38] (fig. 12). In summer it is found throughout the northern half of the United States east of the Great Plains. Its nest commands hardly less admiration than the beauty of its plumage or the excellence of its song. Hanging from the tip of the outermost bough of a stately elm, it is almost inaccessible to depredators and so strongly fastened as to bid defiance to the elements.

Observation both in the field and laboratory shows that caterpillars constitute the largest item of the fare of the oriole. In 204 stomachs they formed 34 per cent of the food, and they are eaten in varying quantities during all the months in which the bird remains in this country. The fewest are eaten in July, when a little fruit also is taken. The other insects consist of beetles, bugs, ants, wasps, grasshoppers, and some spiders. The beetles are principally click beetles, the larvæ of which are among the most destructive insects known; and the bugs include plant and bark lice, both very harmful, but so small and obscure as to be passed over unnoticed by most birds. Ants are eaten mostly in spring, grasshoppers in July and August, and wasps and spiders with considerable regularity throughout the season.

During the stay of the oriole in the United States, vegetable matter amounts to only a little more than 16 per cent of its food, so that the possibility of its doing much damage to crops is very limited. The bird is accused of eating peas to a considerable extent, but remains of such were found in only two cases. One writer says that it damages grapes, but none were found in the stomachs.

[38] *Ioterus galbula.*

BULLOCK ORIOLE.

The Bullock oriole[39] is practically a counterpart of the Baltimore oriole, taking the place of that species west of the Plains and throughout the Pacific coast region. It does not essentially differ in its habits of nesting or in its food from its eastern relative, but it is less beautiful in plumage. The examination of 162 stomachs shows that 79 per cent of its food consists of insects, with a few spiders, a lizard, a mollusk shell, and eggshells. Beetles amounted to 35 per cent, and all except a few ladybugs were harmful species. Ants were found in 19 stomachs, and in one there was nothing else. Bees, wasps, etc., were in 56 stomachs, and entirely filled 2 of them. Including the ants, they amount to nearly 15 per cent of the food of the season.

One of the most interesting articles of food in the oriole's dietary was the black olive scale, found in 45 stomachs, and amounting to 5 per cent of the food. In several cases these scales formed 80 per cent or more of the contents, and in one, 30 individual scales could be counted. They were evidently a standard article of diet, and were eaten regularly in every month of the oriole's stay except April. Hemipterous insects other than scales, eaten quite regularly, make up a little more than 5 per cent of the food. They were mostly stinkbugs, leaf hoppers, and tree hoppers. Plant lice were found in one stomach.

Moths, pupæ, and caterpillars compose the largest item of the oriole's animal food; the average consumption during its summer stay is a little more than 41 per cent. Of these, perhaps the most interesting were the pupæ and larvæ of the codling moth. These were found in 23 stomachs, showing that they are not an unusual article of diet. No less than 14 of the pupal cases were found in one stomach, and as they are very fragile many others may have been present, but broken beyond recognition.

Grasshoppers probably do not come much in the oriole's way. They were eaten, however, to the extent of a little more than 3 per cent. But in spite of the fact that grasshoppers are eaten so sparingly, 2 stomachs, both taken in June, contained nothing else, and another contained 97 per cent of them.

Various insects and spiders, with a few other items, make up the rest of the animal food, a little more than 5 per cent. Spiders are not important in the oriole's food, but are probably eaten whenever found. They were identified in 44 stomachs, but in small numbers. The scales of a lizard were found in one stomach and the shell of a snail in another.

The vegetable contingent of the oriole's food is mostly fruit, especially in June and July, when it takes kindly to cherries and apricots, and sometimes eats more than the fruit grower considers a fair share. However, no great complaint is made against the bird, and it is probable that as a rule it does not do serious harm. With such a good record as an insect eater it can well be spared a few cherries.

THE MEADOWLARKS.

The eastern meadowlark[40] (fig. 13) is a common and well-known bird occurring from the Atlantic coast to the Great Plains, where it gives way to the closely related western species,[41] which extends thence westward to the Pacific. It winters from our southern border as far north as the District of Columbia, southern Illinois, and occasionally Iowa. The western form winters somewhat farther north. Although it is a bird of the plains, and finds its most congenial haunts in the prairies of the West, it is at home wherever there is level or undulating land covered with grass or weeds, with plenty of water at hand.

In the 1,514 stomachs examined, animal food (practically all insects) constituted 74 per cent of the contents and vegetable matter 26 per cent. As would naturally be supposed, the insects were ground species, as beetles, bugs, grasshoppers, and caterpillars, with a few flies, wasps, and spiders. A number of the stomachs were collected when the ground was covered with snow, but even these contained a large percentage of insects, showing the bird's skill in finding proper food under adverse circumstances.

Of the various insects eaten, crickets and grasshoppers are the most important, constituting 26 per cent of the food of the year and 72 per cent of the food in August. It is scarcely necessary to mention the beneficial effect of a number of these birds on a field of grass in the height of the grasshopper season. Of the 1,514 stomachs collected at all seasons of the year, 778, or more than half, contained remains of grasshoppers, and one was filled with fragments of

[39] *Icterus bullocki.* [40] *Sturnella magna.* [41] *Sturnella neglecta.*

37 of these insects. This seems to show conclusively that grasshoppers are preferred, and are eaten whenever they can be found. Especially notable is the great number taken in August, the month when grasshoppers reach their maximum abundance; stomach examination shows that large numbers of birds resort at this time to this diet, no matter what may be the food during the rest of the year.

Next to grasshoppers, beetles make up the most important item of the meadowlark's food, amounting to 25 per cent, about one-half of which are predacious ground beetles. The others are all harmful species.

Forty-two individuals of different kinds of May beetles were found in the stomachs of meadowlarks, and there were probably many more which were past recognition. To this form and several closely allied ones belong the numerous white grubs, which are among the worst enemies to many cultivated crops, notably grasses and grains, and to a less extent strawberries and garden vegetables. In the larval stage they eat the roots of these plants, and being large, one individual may destroy several plants. In the adult stage they feed upon the foliage of trees and other plants, and in this way add to the damage which they began in the earlier form. As these enemies of husbandry are not easily destroyed by man, it is obviously wise to encourage their natural foes.

Among the weevils found in the stomachs the most important economically are the cotton-boll weevil and the recently introduced alfalfa weevil of Utah. Several hundred meadowlarks were taken in the cotton-growing region, and the boll weevil was found in 25 stomachs of the eastern meadowlark and in 16 of the western species. Of the former, one stomach contained 27 individuals. Of 25 stomachs of western meadowlarks taken in alfalfa fields of Utah, 15 contained the alfalfa weevil. In one stomach 23 adults were found, in another 32 adults and 70 larvæ, still another had 10 adults and 40 larvæ, and a fourth had 4 adults and 100 larvæ.

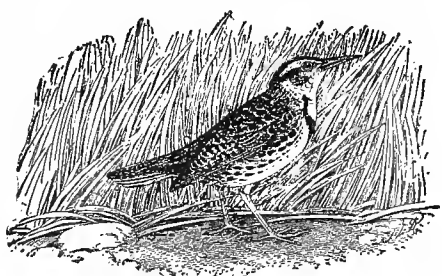


FIG. 13.—Meadowlark. Length, about 10 inches.

Caterpillars form a very constant element of the food, and in May constitute over 24 per cent of the whole. May is the month when the dreaded cutworm begins its deadly career, and then the lark does some of its best work. Most of these caterpillars are ground feeders, and are overlooked by birds which habitually frequent trees, but the meadowlark finds and devours them by thousands. The remainder of the insect food is made up of ants, wasps, and spiders, with some bugs, including chinch bugs, and a few scales.

The vegetable food consists of grain and weed and other hard seeds. Grain in general amounts to 11 per cent and weed and other seeds to 7 per cent. Grain, principally corn, is eaten mostly in winter and early spring and consists, therefore, of waste kernels; only a trifle is consumed in summer and autumn, when it is most plentiful. No trace of sprouting grain was discovered. Clover seed was found in only six stomachs, and but little in each. Seeds of weeds, principally ragweed, barnyard grass, and smartweed, are eaten from November to April, inclusive, but during the rest of the year are replaced by insects. Briefly stated, more than half of the meadowlark's food consists of harmful insects; its vegetable food is composed either of noxious weeds or waste grain; and the remainder is made up of useful beetles or neutral insects and spiders. A strong point in the bird's favor is that, although naturally an insect eater, it is able to subsist on vegetable food, and consequently is not forced to migrate in cold weather farther than is necessary to find ground free from snow.

THE RED-WINGED BLACKBIRDS.

The red-winged or swamp blackbird[42] in its various forms (fig. 14) is found all over the United States and the region immediately to the north. While common in most of its range, its distribution is more or less local, mainly on

[42] *Agelaius phœniceus.*

account of its partiality for marshes. It builds its nest over or near standing water, in tall grass, rushes, or bushes. Owing to this peculiarity the bird may be absent from large tracts of country which afford no swamps or marshes suitable for nesting. It usually breeds in large colonies, though single families, consisting of a male and several females, may sometimes be found in a small slough, where each female builds her nest and rears her own little brood, while her liege lord displays his brilliant colors and struts in the sunshine. In the upper Mississippi Valley the species finds most favorable conditions, for the countless prairie sloughs and the margins of the numerous shallow lakes afford nesting sites for thousands of red-wings; and here are bred the immense flocks which sometimes do so much damage to the grain fields of the West. After the breeding season the birds congregate preparatory to migration, and remain thus associated throughout the winter.

Three species and several subspecies of red-wings are recognized,[48] but practically no difference exists in the habits of these forms either in nesting or feeding, except such as may result from local conditions. Most of the forms are found on the Pacific side of the continent, and may be considered as included in the following statements as to food and economic status.

Many complaints have been made against the red-wing, and several States have at times placed a bounty upon its head. It is said to cause great damage to grain in the West, especially in the upper Mississippi Valley, but few complaints come from the northeastern section, where the bird is much less abundant than in the West and South.

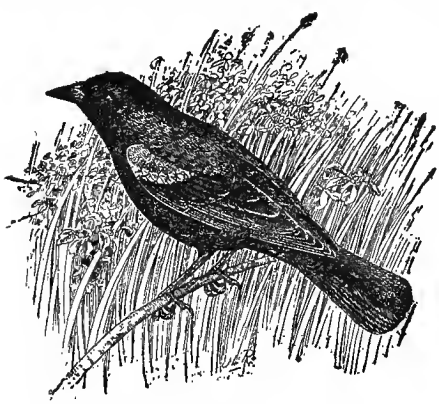


FIG. 14.—Red-winged blackbird. Length, about 9½ inches.

Examination of 1,083 stomachs showed that vegetable matter forms 74 per cent of the food, while animal matter, mainly insects, forms but 26 per cent. A little more than 10 per cent consists of beetles, mostly harmful species. Weevils, or snout beetles, amount to 4 per cent of the year's food, but in June reach 25 per cent. As weevils are among the most harmful insects known, their destruction should condone some, at least, of the sins of which the bird is accused. Grasshoppers constitute nearly 5 per cent of the food, while the rest of the animal matter is made up of various insects, a few snails, and crustaceans. The few dragon flies found were probably picked up dead, for they are too active to be taken alive, unless by a bird of the flycatcher family. So far as the insect food as a whole is concerned, the red-wing may be considered entirely beneficial.

The interest in the vegetable food of this bird centers around grain. Only three kinds, corn, wheat, and oats, were found in the stomachs in appreciable quantities. They aggregate but little more than 13 per cent of the whole food, oats forming nearly half of this amount. Field investigation has shown, however, that, when local conditions are favorable, large flocks of red-wings may do considerable damage. Conspicuous among such cases are the losses suffered by farmers to sweet corn in some of the northeastern States and to milo in the South and West. In the rather limited grain-raising area of the Imperial Valley of California the annual damage to milo alone by enormous flocks of red-wings and yellow-headed blackbirds has been estimated to be fully $50,000. The most important item of the bird's food, however, is weed seed, which forms practically all of its food in winter and about 57 per cent of the fare of the whole year. The principal weed seeds eaten are those of ragweed, barnyard grass, and smartweed. That these seeds are preferred is shown by the fact that the birds begin to eat them in August, when grain is still readily obtainable, and continue feeding on them even after insects become plentiful in April. The red-wing eats very little fruit and does practically no harm to garden or

[48] *Agelaius phœniceus* (8 forms), *Agelaius gubernator*, and *Agelaius tricolor*.

orchard. It is apparent that where moderately abundant, the red-wing does more good than harm, but in sections where it becomes excessively abundant a reduction in its numbers is justifiable.

BOBOLINK.

The bobolink, ricebird, or reedbird [44] (fig. 15) is a common summer resident of the United States, north of about latitude 40°, and from New England westward to the Great Plains, wintering beyond our southern border. In New England there are few birds about which so much romance clusters as this rollicking songster, naturally associated with sunny June meadows; but in the South there are none on whose head so many maledictions have been heaped on account of its fondness for rice. During its sojourn in the Northern States it feeds mainly upon insects and seeds of useless plants; but while rearing its young, insects constitute its chief food, and almost the exclusive diet of its brood. After the young are able to fly, the whole family gathers into a small flock and begins to live almost entirely upon vegetable food. This consists for the most part of weed seeds, since in the North these birds do not appear to attack grain to any great extent. They eat a few oats, but their stomachs do not reveal a great quantity of this or any other grain. As the season advances they gather into larger flocks and move southward, until by the end of August nearly all have left their breeding grounds. On their way they frequent the reedy marshes about the mouths of rivers and on the inland waters of the coast region and subsist largely upon wild rice. In the Middle States, during their southward migration, they are commonly known as reedbirds, and, becoming very fat, are treated as game.

FIG. 15.—Bobolink, rice bird, or reed bird. Length, about 7 inches.

Formerly, when the low marshy shores of the Carolinas and some of the more southern States were devoted to rice culture the bobolinks made great havoc both upon the sprouting rice in spring and upon the ripening grain on their return migration in the fall. While the demage is not so great as when this region was the center of rice production, still it amounts to many thousands of dollars annually. As a remedy, an open season on ricebirds was provided in the Coast States from New Jersey to Florida.

CROW.

In one or another of its geographic races the common crow [45] (fig. 16) breeds in great numbers throughout the States east of the Plains and from the Gulf well up into Canada, while in less abundance it is found in California and in the Northwestern States. During the colder months a southern migratory movement brings most of these birds within the borders of the United States, and at about the latitude of Philadelphia and southern Illinois we find them congregating nightly in roosts. Farmers dwelling in the vicinity of such roosts frequently suffer losses to shocked corn.

In fact, none of our native birds so much concerns the average farmer of the Eastern States as the common crow. Many of our present criticisms of this bird, as its pulling sprouting corn, feeding on ripening ears, damaging fruits of various kinds, destroying poultry and wild birds, and disseminating diseases of live stock, were common complaints in the days of the early colonists. Many of the virtues of the crow, now quite generally recognized, also have been matters of record for many years. In recent times, however, scientific study of these problems, including the examination of the stomachs of hundreds of crows secured in every month of the year and under a variety of conditions, has enabled us to render a much fairer verdict than was formerly possible.

---

[44] *Dolichonyx oryzivorus.*

[45] *Corvus brachyrhynchos.*

The crow is practically omnivorous. During spring and early summer any form of insect life seems to make a desirable item in its diet, and in winter when hard pressed nothing in the animal or vegetable kingdoms which contains a morsel of nutriment is overlooked.

The insect food of the crow, which comprises about a fifth of its yearly sustenance, does much to atone for its misdemeanors. Grasshoppers, May beetles and their larvæ (white grubs), caterpillars, weevils, and wireworms stand out prominently. In 1,340 stomachs of adults examined these highly injurious forms comprised over 80 per cent of the insect food. Grasshoppers are naturally taken in greatest abundance late in the season, September being the month of largest consumption, when they form about a fifth of the total food. May beetles and white grubs are eaten in every month, but occur most prominently in May. In June caterpillars are a favorite food, and weevils of various kinds are taken in varying quantities throughout summer and fall. About half of the remaining 20 per cent of insect food is composed of beneficial ground beetles, ladybirds, predacious bugs, and parasitic wasps, and related forms, the rest consisting of neutral or injurious forms. Numerous instances are on record where fields badly infested with white grubs or grasshoppers have been favorite resorts of crows, whose voracity has resulted in a material suppression of the pest. When the amount of food required to sustain the individual crow is considered, the work of these birds appears all the more important. Single stomachs containing upward of 50 grasshoppers are not uncommon. Thus in its choice of insect food the crow is rendering an important service to the farmer.

FIG. 16.—Crow. Length, about 19 inches.

In the other animal food of the crow are several items of the utmost economic importance. Spiders are taken in considerable numbers in May and June, but the yearly total is a little over 1 per cent of the food. In early spring crawfish are eagerly sought, and other aquatic food, as fish and mollusks, lend variety to the crow's bill of fare the year round. In the consumption of toads, salamanders, frogs, and some snakes, which together compose a little over 2 per cent of the yearly food, the crow is doubtless doing harm. Small rodents occurred in the stomachs collected nearly every month, but it is often difficult to determine whether small mammals found in birds' stomachs were taken alive or found dead.

From its carrion-eating habits the crow has been unfairly criticized as a disseminator of live-stock diseases. While this may be to some extent just, the fact that there are many other important carriers which lie largely beyond our control, shows that we must seek final relief only through the strictest methods of sanitation.

The nest-robbing habit of the crow, long a serious criticism, is verified by stomach analysis. Of the 1,103 crows examined, 47 had fed on wild birds or their eggs, and the eggs of domestic fowls were found somewhat more frequently. The crow's habit of rummaging about garbage piles may explain much of this latter material.

Of the vegetable food, corn, which is eaten every month, is the most important item and forms about 38 per cent of the diet. Much of this, however, must be considered waste, since over 60 per cent of it is consumed from the first of November to the end of March. During the periods when corn is sprouting and when in the "roasting-ear" stage the crow is eating this grain at a rate considerably less than the yearly average, and the months of smallest consumption are July and August. At times, however, the damage to corn becomes a serious problem, and were it not possible to make use of such deterrents as coal tar upon seed corn there would be little friendship for the crow in some sections of the East. The "pulling" of corn is a trait most prevalent in small-field areas. Wheat and oats suffer similar damage at times, especially in the Northwestern States, where these grains predominate. About the only safeguard to ripening grain is the constant use of powder and shot or the scarecrow.

Various kinds of cultivated fruits are also eaten, and local damage to such crops as apples, melons, peas, beans, peanuts, and almonds is occasionally reported. In long, rigorous winters, the crow, like other birds, resorts to the fruit of numerous wild plants, as dogwood, sour gum, hackberry, smilax, and the several species of sumac and poison ivy.

Damage to the eggs of poultry may be reduced to a minimum by careful housing of laying hens, and the farmer can protect his sprouting grain to a large extent by the use of tar-coated seed. It will be well also to keep the crow within reasonable numbers on game preserves and public parks where it is desired to encourage the nesting of smaller birds. While legal protection is not needed for so wary an individual as the crow, it seems well, where local conditions have not aggravated some particular shortcomings of the bird, to allow it to continue the good services rendered to man in the destruction of noxious insects.

BLUE JAY.

The blue jay [46] (fig. 17) is a conspicuous member of our bird population east of the Plains, especially in autumn when his brilliant plumage contrasts vividly with the brown foliage. Even in winter he stays with us, though at this time he is less common along our northern border. In spring and summer, while by no means uncommon, the blue jay is not so often noticed, as the retiring disposition which he assumes during the breeding season assists in protecting him from enemies. This also allows him to carry on with considerable impunity that inglorious practice of nest robbing of which, in a measure, he has been rightfully accused.

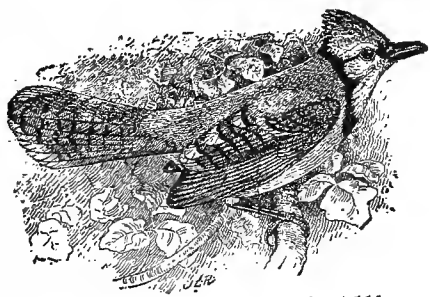


FIG. 17.—Blue jay. Length, about 11½ inches.

Examination of 530 stomachs collected at all times of the year in 30 of our Eastern States and Canada shows that insects comprise about 22 per cent of the yearly sustenance. About three-fourths of these are injurious, the remainder being neutral or beneficial. Of the injurious insects, grasshoppers form the largest portion; in August nearly a fifth of the food. Caterpillars are conspicuous in July and August and at this time average about a tenth of the stomach contents. Both laboratory investigations and field observations have established the fact that in winter the eggs of the tent caterpillar and the hibernating larvæ of the brown-tail moth in New England are eagerly sought. Scarabæid beetles form about 4 per cent of the yearly food, and click beetles and wire-worms about 1 per cent. Of the beneficial forms, ground beetles (3 per cent) and hymenopterous insects, part of which are parasitic (2.5 per cent), are taken most frequently. A few other invertebrates, as spiders, millepeds, mollusks, and crustaceans, also are eaten throughout the year.

In the consideration of the vertebrate food of the blue jay we are confronted with the problem of the destruction of wild birds and their eggs. Special search was made for every possible trace of such material in the stomachs, and in 6 of the 530 were found the remains of wild birds or their eggs. In February two jays had killed a small bird apiece; in May one had robbed a nest of eggs; in June two had taken a small bird and a clutch of eggs, respectively; and in August another had robbed a nest. As this trait of the jay appears to be most pronounced during its own breeding season, it is quite possible for many birds which have suffered from its boldness early in the season to raise another brood unmolested. Thirty-nine of the 530 jays examined had fed on hen's eggs. Much of this food, however, was picked up about rubbish heaps, to which the jay, like other members of the crow family, is partial. While the result of stomach analysis would appear to belittle this fault of the blue jay, it is doubtless quite characteristic of the bird under favorable conditions.

Complaint that the jay is the source of considerable damage to corn in the fall has been verified to a certain degree by stomach examination. This grain

[46] *Cyanocitta cristata.*

is taken in every month of the year, but in greater quantities during winter and early spring, when much of it is necessarily waste, and it forms about 18 per cent of the yearly food. Cultivated fruits of various kinds are eaten from June to the end of the year, and the 15 per cent taken in July apparently justifies complaints against the bird on this score. The favorite vegetable food of the blue jay is mast of various kinds, acorns predominating, but beechnuts, chestnuts, chinquaquins, and hazelnuts also are relished. This food is important in every month but July and August, the yearly average being over 43 per cent, and from October to March it constitutes about two-thirds of the diet. Occasionally harm is done by feeding also on cultivated nuts, as pecans. Wild fruits are eaten during the summer and fall and constitute about 7 per cent of the yearly sustenance.

The blue jay probably renders its best services to man in destroying grasshoppers late in the season and in feeding on hibernating insects and their eggs, as it does in the case of the tent caterpillar and brown-tail moth. Such forest insects as buprestid beetles and weevils of various kinds also fall as its prey.

The blue jay's vegetable food, with the exception of some cultivated fruit and corn in the fall, is largely neutral. The severest criticism against the species is the destruction of other birds and their eggs. Where we wish to attract birds in large numbers about our dooryards, in our parks, and in game preserves, it will be well not to allow the jays to become too abundant.

PACIFIC COAST JAYS.

In California and adjacent States two species of jays are much in evidence under several more or less well-marked forms.

The Steller jay[47] much resembles the eastern bird, but it is more shy and retiring and seldom visits the orchard or vicinity of the ranch buildings. Stomach examination shows that its food does not radically differ from that of the eastern blue jay. As is the case with that bird, a very considerable part of the food consists of mast, together with a little fruit and some insects. The insects are largely wasps, with some beetles and grasshoppers. This jay also eats some grain, which is probably waste or volunteer. No complaints, so far as known, are made against this bird. Until it shall become less wary it is not likely to trespass to a serious extent upon the farmer's preserve.

The California jay,[48] although of a different genus, more nearly resembles its eastern relative in food habits and actions. It freely visits the stockyards near ranch buildings, and orchards and gardens. As a fruit stealer it is notorious. One instance is recorded where seven jays were shot from a prune tree, one after the other, the dead bodies being left under the tree until all were killed. So eager were the birds to get the fruit that the report of the gun and the sight of their dead did not deter them from coming to the tree. In orchards in canyons or on hillsides adjacent to chaparral or other cover great mischief is done by this bird. In one such case an orchard was under observation at a time when the prune crop was ripening, and jays in a continuous stream were seen to come down a small ravine to the orchard, prey upon the fruit, and return.

Fruit stealing, however, is only one of the sins of the California jay. That it robs hens' nests is universal testimony. A case is reported of a hen having a nest under a clump of bushes; every day a jay came to a tree a few rods away, and when it heard the cackle of the hen announcing a new egg it flew at once to the nest. At the same time the mistress of the house hastened to the spot to secure the prize, but in most cases the jay won the race. This is only one of many similar cases recounted. The jays have learned just what the cackle of the hen means. Another case more serious is that related by a man engaged in raising white leghorn fowls on a ranch several miles up a canyon. He stated that when the chicks were very young the jays attacked and killed them by a few blows of the beak and then pecked open the skull and ate out the brains. In spite of all efforts to protect the chicks and kill the jays the losses in this way were serious.

Examination of the stomachs of 326 California jays shows that 27 per cent of the contents for the year consists of animal matter and 73 per cent of vegetable. Although the great bulk of the animal food is made up of insects, the remains of eggshells and birds' bones appear much too often. The insect food is fairly well distributed among the more common orders, but grasshoppers are

[47] *Cyanocitta stelleri.* [48] *Aphelocoma californica.*

slightly the most numerous and constitute 4.5 per cent of the year's food. In July, August, and September, however, the amount is 14, 18, and 19 per cent, respectively. Four per cent of the food consists of wasps, bees, etc., but in the three months named they constitute 15, 7, and 9 per cent, respectively. A worker honeybee found in each of two stomachs is rather surprising, for it is unusual to find a bird like the jay eating these active and elusive insects, which enter into the diet of the flycatchers. The remainder of the insect food is pretty evenly distributed among beetles, bugs, flies, and caterpillars. Eggshells were found in 21 stomachs and birds' bones in 5. Six stomachs contained the bones of mammals and two those of a lizard. No bird has a worse reputation for nest robbing than has the eastern jay, and yet of 530 stomachs of the eastern species only 6 contained eggshells or the bones of birds. This comparison serves to show what a marauder and nest thief the California jay really is.

In its vegetable diet this bird much resembles its eastern relative, the most remarkable difference being in the matter of fruit eating. With greater opportunities the California bird has developed a greater appetite for fruit and indulges it to the fullest extent. Remains of fruit were found in 220 of the 326 stomachs. The percentage for the year is only 16, but for the four months of June, July, August, and September it is 44, 33, 53, and 25, respectively. Cherries, apricots, and prunes are the favorites among cultivated fruits, and elderberries are relished to some extent. Grain, which was found in 48 stomachs, amounts to 6 per cent of the food of the year. Practically all of it was taken in the four months above mentioned, but it is not probable that much damage is done by the jay in this respect. The major portion of the grain was oats. What was not wild was probably simply scattered grain gleaned after the harvest. Mast is eaten by the California jay from September to March, inclusive, and constitutes during most of that period one of the principal elements of its food. In this respect the bird shows a remarkable similarity to the eastern species. A few weed seeds and other miscellaneous items make up the balance of the vegetable food.

In summing up from an economic point of view the character of the food of the California jay, it must be conceded that it is not all that could be wished. Its taste for birds' eggs and fruit is entirely too pronounced, and at present the species is superabundant in California. While the natural food supply of the bird has been lessened by bringing the woods and brushy canyons under cultivation, the same areas have been planted to fruit, and naturally the jay takes the fruit as an acceptable substitute. A considerable reduction of the bird's numbers would appear to be the only effective remedy.

THE PHŒBES.

Among the early spring arrivals to their northern homes none is more welcome than the phœbe (fig. 18). The common phœbe[49] breeds throughout the United States east of the Great Plains, and winters from the South Atlantic and Gulf States southward. Its western relative, the black phœbe,[50] is found from Texas west to the Pacific coast, which it occupies as far north as Washington, replacing through most of this region the common or eastern form.

Though naturally building its nest under an overhanging cliff of rock or earth, or in the mouth of a cave, the preference of the eastern species for the vicinity of farm buildings is so marked that in the more thickly settled parts of the country the bird is seldom seen at any great distance from a farmhouse, except where a bridge spanning a stream affords a secure spot for a nest. Its confiding disposition renders it a great favorite, and consequently it is seldom disturbed.

The phœbe subsists almost exclusively upon insects, most of which are caught upon the wing. An examination of 370 stomachs showed that over 89 per cent of the year's food consists of insects and spiders, while wild fruit constitutes the remainder. The insects belong chiefly to noxious species, and include many click beetles, May beetles, and weevils. Other beetles, belonging to 21 families that were identified, make up 10.65 per cent. They appear to be eaten very regularly in every month, but the most are taken in spring and early summer. May is the month of maximum consumption, with 20.43 per cent. Beetles altogether amount to 15.3 per cent, which places them second in rank of the items

[49] *Sayornis phœbe.* [50] *Sayornis nigricans.*

of animal food. The notorious cotton-boll weevil was found in six stomachs taken in the cotton fields of Texas and Louisiana, and five individuals of the strawberry weevil were taken from one collected in Texas. Many other beetles contained in the stomachs are equally harmful, but are not so widely known. Such are the corn leaf-beetle, which feeds upon corn; the 12-spotted cucumber beetle, and the striped cucumber beetle, both of which seriously injure and sometimes destroy cucumber and squash vines; and the locust leaf miner, which is sometimes so numerous that all the locust trees over large areas are blasted as by fire.

In the phœbe's diet hymenopterous insects stand at the head, as is the case with most of the flycatchers. They are eaten with great regularity and are the largest item in nearly every month. A few are useful parasitic species, but these are offset by a number of sawfly larvæ, which are very harmful insects. Ants were found in 24 stomachs. No honeybees were identified. In their season grasshoppers are much relished, while wasps of various forms, many flies of species that annoy cattle, and a few bugs and spiders are also eaten regularly. It is evident that a pair of phœbes must materially reduce the number of insects near a garden or field, as the birds often, if not always, raise two broods a year, and each brood numbers from four to six young.

There is hardly a more useful species about the farm than the phœbe, and it should receive every encouragement. To furnish nesting boxes is helpful, but not necessary, as it usually prefers a more open situation, like a shed or a nook under the eaves, but it should be protected from cats and other marauders.

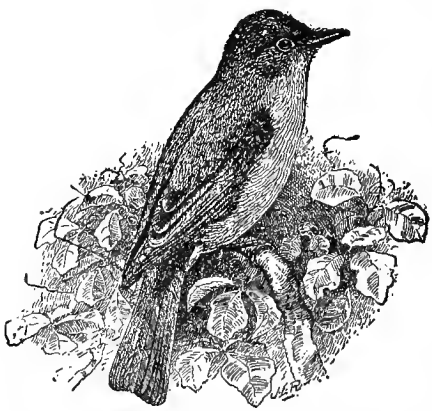


FIG. 18.—Phœbe. Length, about 6½ inches.

The black phœbe has the same habits as its eastern relative, both as to selection of food and nesting sites, preferring for the latter purpose some structure of man, as a shed or, better still, a bridge over a stream of water, and the preference of the black phœbe for the vicinity of water is very pronounced. One may always be found at a stream or pool and often at a watering trough by the roadside.

Careful study of the habits of the bird shows that it obtains a large portion of its food about wet places. While camping beside a stream in California the writer took some pains to observe the habits of the black phœbe. The nesting season was over, and the birds had nothing to do but eat. This they appeared to be doing all the time. When first observed in the morning, at the first glimmer of daylight, a phœbe was always found flitting from rock to rock, although it was so dusky that the bird could hardly be seen. This activity was kept up all day. Even in the evening, when it was so dark that notes were written by the aid of the camp fire, the phœbe was still engaged in its work of collecting, though it was difficult to understand how it could catch insects when there was scarcely light enough to see the bird. Exploration of the stream showed that every portion of it was patrolled by a phœbe, that each one apparently did not range over more than 12 or 13 rods of water, and that sometimes two or three were in close proximity.

The number of insects destroyed in a year by the black phœbe is enormous. Fortunately, the examination of stomachs has supplemented observation in the field, and we are enabled to give precise details. Of the 333 stomachs examined, every one contained insects as the great bulk of the food. Only 15 contained any vegetable food at all, and in no case was it a considerable part of the contents of the stomach. The insects eaten were mostly wasps, bugs, and flies, but many beetles also were destroyed.

Useful beetles belonging to three families amount to 2.8 per cent of the food. Other beetles of harmful or neutral species reach 10.5 per cent. Wasps, the largest item of the food, were found in 252 stomachs and were the whole contents of 15. The average for the year is 35 per cent. Parasitic species

were noted, but they were very few. Ants were found in 48 stomachs, and for a short time in midsummer they constitute a notable part of the food. Various wild bees and wasps make up the bulk of this item. No honeybees were found.

Bugs in various forms constitute 10.56 per cent and are eaten in every month but May. Stinkbugs appear to be the favorites, as they were contained in 10 stomachs. Plant lice were found in one stomach. Flies, forming the second largest item, were found in 97 stomachs and completely filled 3. They constitute the most regular article in the black phœbe's diet. The maximum consumption occurs in April, 64.3 per cent. The black phœbe well merits its title of flycatcher.

Moths and caterpillars amount to 8.2 per cent of the food. They were found in 72 stomachs, of which 51 contained the adult moths and 28 the larvæ or caterpillars. One stomach was entirely filled with adults. This is one of the few birds studied by the writer that eats more moths than caterpillars, for as a rule the caterpillars are largely in excess. Flycatchers, taking their food upon the wing, would naturally prove exceptions to the rule. Crickets are evidently not a favorite food of the black phœbe, as they amount to only 2.45 per cent. They were found in 39 stomachs, but usually the amount in each was small, though one stomach was entirely filled with them. Grasshoppers did not appear. Dragon flies were eaten to some extent, and these illustrate the fondness of the species for the neighborhood of water.

The vegetable matter eaten consisted chiefly of small wild fruits of no economic importance.

Another phœbe inhabiting the Western States and breeding as far north as Alaska is the Say phœbe.[51] Investigation of its food was based on the examination of 86 stomachs, and while none were available for the months when insects are most numerous, the bird proved to be one of the most exclusively insectivorous of the family. That it takes a few useful insects can not be denied, but these are far outnumbered by the harmful ones it destroys, and the balance is clearly in favor of the bird. Its vegetable food amounts to only 2 per cent and is made up of a little wild fruit, seeds, and rubbish.

THE KINGBIRDS.

The well-known eastern kingbird[52] (fig. 19) is essentially a lover of the orchard, though groves and the edge of forests were probably its original habitat. It breeds in the States east of the Rocky Mountains, and less commonly in the Great Basin and on the Pacific coast. Its hostility to hawks and crows is proverbial, and for this reason a family of kingbirds is a desirable adjunct to a poultry yard. On one occasion in the knowledge of the writer a hawk which attacked a brood of young turkeys was pounced upon and so severely buffeted by a pair of kingbirds whose nest was near by that the would-be robber was glad to escape without his prey. Song birds that nest near the kingbird are similarly protected.

The kingbird is largely insectivorous. It is a true flycatcher and takes on the wing a large part of its food. It does not, however, confine itself to this method of hunting, but picks up some insects from trees and weeds, and even descends to the ground in search of myriapods or thousand legs. The chief complaint against the species by both professional bee keepers and others has been that it preys largely upon honeybees. One bee raiser in Iowa, suspecting the kingbirds of feeding upon his bees, shot a number near his hives; but when the stomachs of the birds were examined by an expert entomologist, not a trace of honeybees could be found.

An examination of 665 stomachs collected in various parts of the country was made by the Biological Survey, but only 22 were found to contain remains of honeybees. In these 22 stomachs there were in all 61 honeybees, of which 51 were drones, 8 were certainly workers, and the remaining 2 were too badly broken to be further identified.

The insects that constitute the great bulk of the food of the bird are noxious species, largely beetles—May beetles, click beetles (the larvæ of which are known as wire worms), weevils, which prey upon fruit and grain; and a host of others. Wasps, wild bees, and ants are conspicuous elements of the food, far outnumbering the hive bees. During summer many grasshoppers and crickets, as well as leaf hoppers and other bugs, also are eaten. In the stomachs examined were a number of robber flies—insects which prey largely upon other

[51] *Sayornis sayus.* [52] *Tyrannus tyrannus.*

insects, including honeybees, and which are known to commit in this way extensive depredations. It is thus evident that the kingbird by destroying these flies actually does good work for the apiarist. The 26 robber flies found in the stomachs may be considered more than an equivalent for the 8 worker honeybees already mentioned. A few caterpillars are eaten, mostly belonging to the group commonly known as cutworms, all the species of which are harmful.

About 11 per cent of the food consists of small native fruits, comprising some 30 common species of the roadsides and thickets, as dogwood berries, elderberries, and wild grapes. The kingbird is not reported as eating cultivated fruit to an injurious extent, and it is very doubtful if this is ever the case.

In the Western States the Arkansas kingbird[55] is not so domestic in its habits as its eastern relative, preferring to live among scattering oaks on lonely hillsides, rather than in orchards about ranch buildings. The work it does, however, in the destruction of noxious insects fully equals that of any member of its family. Like other flycatchers, it subsists mostly upon insects taken in midair, though it eats a number of grasshoppers, probably taken from the ground. The bulk of its food consists of beetles, bugs, wasps, and wild bees. Like its eastern representative, it has been accused of feeding to an injurious extent upon honeybees. In an examination of 62 stomachs of this species, great care was taken to identify every insect or fragment that had any resemblance to a honeybee; as a result, 30 honeybees were identified, of which 29 were males or drones and 1 a worker. These were contained in four stomachs, and were the sole contents of three; in the fourth they constituted 99 per cent of the food. It is evident that the bee-eating habit is only occasional and accidental, rather than habitual; and it is also evident that if this ratio of drones to workers were maintained, the bird would be of more benefit than harm to the apiary.

FIG. 19.—Kingbird. Length, about 8½ inches.

The Cassin kingbird [54] has a more southerly range than the Arkansas flycatcher. Examination of a number of stomachs shows that its food habits are similar to those of others of the group.

Three points seem to be clearly established in regard to the food of the kingbirds—(1) that about 90 per cent consists of insects, mostly injurious species; (2) that the alleged habit of preying upon honeybees is much less prevalent than has been supposed, and probably does not result in any great damage; and (3) that the vegetable food consists almost entirely of wild fruits which have no economic value.

All of the kingbirds are of the greatest importance to the farmer and fruit grower, as they destroy vast numbers of harmful insects, and do no appreciable damage to any product of cultivation.

NIGHTHAWK.

The nighthawk, or bull-bat,[56] breeds throughout most of the United States and Canada, and winters in South America. It is strictly insectivorous, and hence does no damage to crops. The only charge that can be made against the bird is that it destroys some useful insects, but these are greatly in the minority in its food.

Nighthawks are so expert in flight that no insects can escape them. In their capacious mouths they sweep up everything from the largest moths and dragon flies to the tiniest ants and gnats, and in this way sometimes gather most remarkable collections of insects. Several stomachs have contained 50 or more different kinds, and the number of individuals ran into the thousands.

[53] *Tyrannus verticalis.* [54] *Tyrannus vociferans.*
[55] *Chordeiles virginianus.*

Nearly a fourth of the birds' total food is composed of ants. These insects are generally annoying and often very injurious, especially on account of their damage to stored products and because of their habit of fostering destructive plant lice. More than a fifth of the nighthawk's food consists of June bugs, dung beetles, and other beetles of the leaf-chafer family. These are the adults of white grubs, noted pests, and even as adults many members of the family are decidedly harmful.

Numerous other injurious beetles, as click beetles, wood borers, and weevils, are relished. True bugs, moths, flies, grasshoppers, and crickets also are important elements of the food. Several species of mosquitoes, including the transmitter of malaria, are eaten. Other well-known pests consumed by the nighthawk are Colorado potato beetles, cucumber beetles, rice, clover-leaf, and cotton-boll weevils, bill bugs, bark beetles, squash bugs, and moths of the cotton worm.

Nighthawks are much less numerous than formerly, chiefly because of wanton shooting. They are given full legal protection almost everywhere, and citizens should see that the law is obeyed. The bird is far too useful and attractive to be persecuted.

THE WOODPECKERS.

Five or six species of woodpeckers are familiarly known throughout the eastern United States, and in the West are replaced by others of similar habits. Several species remain in the Northern States through the entire year, while others are more or less migratory.

Farmers are prone to look upon woodpeckers with suspicion. When the birds are seen scrambling over fruit trees and pecking holes in the bark, it is concluded that they must be doing harm. Careful observers, however, have noticed that, excepting a single species, these birds rarely leave any conspicuous mark on a healthy tree, except when it is affected by wood-boring larvæ, which are accurately located, dislodged, and devoured by the woodpecker.

FIG. 20.—Hairy woodpecker. Length, about 9 inches.

Two of the best-known woodpeckers, the hairy woodpecker [56] (fig. 20) and the downy woodpecker,[57] including their races, range over the greater part of the United States. They differ chiefly in size, their colors being practically the same. The males, like those of many other woodpeckers, are distinguished by a scarlet patch on the head. An examination of many stomachs of these two species shows that from two-thirds to three-fourths of the food consists of insects, chiefly noxious kinds. Wood-boring beetles, both adults and larvæ, are conspicuous, and with them are associated many caterpillars, mostly species that burrow into trees. Next in importance are the ants that live in decaying wood, all of which are sought by woodpeckers and eaten in great quantities. Many ants are particularly harmful to timber, for if they find a small spot of decay in the vacant burrow of a wood borer, they enlarge the hole, and, as their colony is always on the increase, continue to eat away the wood until the whole trunk is honeycombed. Moreover, they are not accessible to birds generally, and could pursue their career of destruction unmolested were it not that the woodpeckers, with beaks and tongues especially fitted for such work, dig out and devour them. It is thus evident that woodpeckers are great conservators of forests. To them more than to any other agency we owe the preservation of timber from hordes of destructive insects.

---

[56] *Dryobates villosus.* [57] *Dryobates pubescens.*

One of the larger woodpeckers familiar to everyone is the flicker, or golden-winged woodpecker[58] (fig. 21), which is generally distributed throughout the United States from the Atlantic coast to the Rocky Mountains. There it is replaced by the red-shafted flicker,[59] which extends westward to the Pacific. The two species are as nearly identical in food habits as their respective environments will allow. The flickers, while genuine woodpeckers, differ somewhat in habits from the rest of the family, and are frequently seen searching for food upon the ground. Like the downy and hairy woodpeckers, they feed upon wood-boring grubs and ants, but the number of ants eaten is much greater than that eaten by the other two species. Of the flickers' stomachs examined, three were completely filled with ants. Two of these contained more than 3,000 individuals each, while the third contained fully 5,000. These ants belong to species which live in the ground. It is these insects for which the flicker searches when it runs about in the grass, although some grasshoppers also are then taken. The flicker's habit of pecking holes in buildings sometimes greatly annoys its human friends, and it is particularly noticeable in the California species. Observation has shown that the object of the work is to obtain shelter for the winter. In the East most of the flickers are migratory, and only a few remain North where shelter is necessary. These generally find a safe retreat in the hollow tree in which they nested. In California, however, where the birds do not migrate, trees are not so abundant as in the East, and consequently buildings are brought into requisition, and in them holes are drilled, usually under the eaves, where snug nights' lodgings are found. Often a dozen holes may be seen in one building. Barns or other outbuildings are usually selected, though churches sometimes have been used.

FIG. 21.—Flicker. Length, about 12½ inches.

The red-headed woodpecker[60] (fig. 22) is well known east of the Rocky Mountains, but is rather rare in New England. Unlike some of the other species, it prefers fence posts and telegraph poles to trees as a foraging ground. Its food therefore naturally differs from that of the preceding species, and consists largely of adult beetles and wasps which it frequently captures on the wing after the fashion of flycatchers. Grasshoppers also form an important part of the food. Among the beetles are a number of predacious ground species and some tiger beetles, which are useful insects. The red-head has been accused of robbing nests of other birds, and of pecking out the brains of young birds and poultry; but as the stomachs showed little evidence to substantiate this charge, the habit probably is exceptional.

FIG. 22.—Red-headed woodpecker. Length, about 9½ inches.

The vegetable food of woodpeckers is varied, but consists largely of small fruits and berries. The downy and hairy woodpeckers eat such fruits as dog-

[58] *Colaptes auratus.* [59] *Colaptes cafer collaris.*
[60] *Melanerpes erythrocephalus.*

wood and Virginia creeper and seeds of poison ivy, sumac, and a few other shrubs. The flicker also eats a great many small fruits and the seeds of a considerable number of shrubs and weeds. None of the three species is much given to eating cultivated fruits or crops. The red-head has been accused of eating the larger kinds of fruit, as apples, and also of taking considerable corn. Stomach examinations show that to some extent these charges are substantiated, but that the habit is not prevalent enough to cause much damage. The bird is fond of mast, especially beechnuts, and when these nuts are plentiful it remains north all winter.

Woodpeckers apparently are the only agents which can successfully cope with certain insect enemies of the forest, and, to some extent, with those of fruit trees also. For this reason, if for no other, they should be protected in every possible way.

THE CUCKOOS.

Two species of cuckoos are common in the United States east of the Great Plains, the yellow-billed cuckoo[61] (fig. 23) and the black-billed cuckoo,[62] and in the West a relative of the yellow-bill, the California cuckoo,[63] ranges from Colorado and Texas to the Pacific coast. While the two species are quite distinct, the food habits of the yellow-bill and the black-bill do not greatly differ and their economic status is practically the same.

Examination of 155 stomachs has shown that these species are much given to eating caterpillars, and, unlike most birds, do not reject those covered with hair. In fact, cuckoos eat so many hairy caterpillars that the hairs pierce the inner lining of the stomach and remain there, and often when the stomach is opened it appears to be lined with a thin coating of fur.

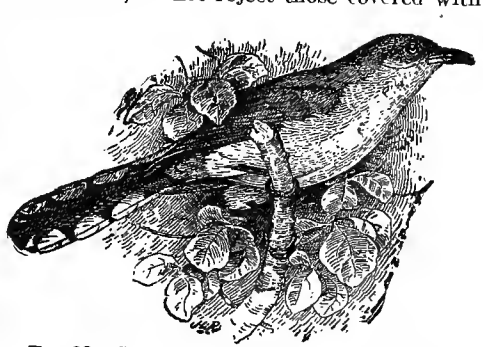


FIG. 23.—Yellow-billed cuckoo. Length, about 12 inches.

An examination of the stomachs of 46 black-billed cuckoos, taken during the summer months, showed the remains of 906 caterpillars, 44 beetles, 96 grasshoppers, 100 sawflies, 30 stinkbugs, and 15 spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy, and many of them belong to a genus that lives in colonies and feeds on the leaves of trees, including the apple tree. One stomach was filled with larvæ of a caterpillar belonging to the same genus as the tent caterpillar, and possibly to that species. Other larvæ were those of large moths, for which the bird seems to have a special fondness. The beetles were for the most part click beetles and weevils, as well as a few May beetles. The sawflies were contained in two stomachs, one of which held no less than 60 in the larval stage.

Of the yellow-billed cuckoo, 109 stomachs (collected from May to October) were examined. They contained 1,865 caterpillars, 93 beetles, 242 grasshoppers, 37 sawflies, 69 bugs, 6 flies, and 86 spiders. As in the case of the black-billed cuckoo, most of the caterpillars belonged to hairy species and many of them were of large size. One stomach contained 250 American tent caterpillars; another 217 fall webworms. The beetles were distributed among several families, all more or less harmful to agriculture. In the same stomach which contained the tent caterpillars were 2 Colorado potato beetles; in another were 3 goldsmith beetles, and remains of several other large beetles. Besides the ordinary grasshoppers were several katydids and tree crickets. The sawflies were in the larval stage, in which they resemble caterpillars so closely that they are commonly called false caterpillars by entomologists. The bugs consisted of stinkbugs and cicadas, or dog-day harvest flies, with the single exception of one wheel bug, which was the only useful insect eaten.

---

[61] *Coccyzus americanus.* [62] *Coccyzus erythropthalmus.*
[63] *Coccyzus americanus occidentalis.*

BOBWHITE.

No bird is better known to country residents than the bobwhite[64] (see illustration on title-page). The bird's cheery calls the year round form part of the most pleasant associations of country life, and its neat form and harmonious coloration, and especially its confiding habits, make it a general favorite.

Any bushy fence row serves as a retreat for its nest, or for winter shelter, and weed-covered fields are its favorite feeding places. Weed seeds form more than half the total food and include those of all the worst weed pests of the farm. Among them may be mentioned crab, cockspur, witch, and foxtail grasses, sheep sorrel, smartweed, bindweed, lamb's-quarters, pigweeds, corn cockle, chickweed, charlock, partridge pea, beggar lice, nail grass, rib grass, rag weed, and Spanish needles.

Acorns, beechnuts, chestnuts, and pine seeds make up about 2.5 per cent of the food, and wild fruit about 10 per cent. The fruits include berries of palmetto, smilax, wax myrtle, mulberry, sassafras, blackberries and raspberries, rose haws, cherry, sumac, grapes, sour gum, blueberries, honeysuckle, partridge berry, and a number of others. The bobwhite feeds to a slight extent upon buds and leaves, including those of yellow and red sorrel, cinquefoil, and clover.

Grain forms scarcely more than a sixth of the food, and most of it is taken during winter and early spring when nothing but waste grain is available. The habit of gleaning this after the harvest is beneficial to the farm, for volunteer grain is not desirable, especially where it serves to maintain certain insect and fungus pests. Although most of the grain and seed crops grown upon the farm are represented in bobwhite's dietary, no significant damage can be attributed to the bird.

Animal food, chiefly insects, composed nearly a sixth of the bird's subsistence. From June to August, inclusive, when insects are most numerous, their proportion in the food is about 36 per cent. The variety of insect food is great and includes a number of the most destructive agricultural pests. Among them may be mentioned the Colorado potato beetle, 12-spotted cucumber beetle, bean leaf beetle, squash ladybird, wireworms, May beetles, corn billbugs, clover leaf weevil, army worm, bollworm, cutworms, and chinch bug.

The food habits of the bobwhite undoubtedly are beneficial and the bird should be maintained in numbers on every farm. This is not to say that all shooting should be prohibited, for the bird is very prolific. But its numbers should not be reduced below what the available nesting sites and range will support. On the other hand the policy of absolute protection recently adopted by one of the States is not called for by strictly economic considerations.

---

[64] *Colinus virginianus.*

PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RELATING TO THE FOOD HABITS OF WILD BIRDS.

FOR FREE DISTRIBUTION BY THE DEPARTMENT.

The English Sparrow as a Pest. (Farmers' Bulletin 498.)
Some Common Game, Aquatic, and Rapacious Birds in Relation to Man. (Farmers' Bulletin 497.)
Food of Some Well-known Birds of Forest, Farm, and Garden. (Farmers' Bulletin 506.)
Some Common Birds Useful to the Farmer. (Farmers' Bulletin 630.)
Common Birds of Southeastern United States in Relation to Agriculture. (Farmers' Bulletin 755.)
The Crow and Its Relation to Agriculture. (Farmers' Bulletin 1102.)
Canaries: Their Care and Management. (Farmers' Bulletin 1327.)
Eleven Important Wild-duck Foods. (Department Bulletin 205.)
Propagation of Wild-duck Foods. (Department Bulletin 465.)
Food Habits of Seven Species of American Shoal-water Ducks. (Department Bulletin 862.)
Economic Value of the Starling in the United States. (Department Bulletin 868.)
Wild Ducks and Duck Foods of the Bear River Marshes, Utah. (Department Bulletin 936.)
Food Habits of the Swallows. (Department Bulletin 619.)
Farm Help from the Birds. (Yearbook Separate 843.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Fifty Common Birds of Farm and Orchard. (Farmers' Bulletin 513, colored plates.) Price, 15 cents.
Birds in Relation to the Alfalfa Weevil. (Department Bulletin 107.) Price, 15 cents.
Food Habits of the Thrushes of the United States. (Department Bulletin 280.) Price, 5 cents.
The Crow and Its Relation to Man. (Department Bulletin 621.) Price, 15 cents.
The Relation of Sparrows to Agriculture. (Biological Survey Bulletin 15.) Price, 10 cents.
Birds of a Maryland Farm. (Biological Survey Bulletin 17.) Price, 20 cents.
Birds of California in Relation to the Fruit Industry. (Biological Survey Bulletin 34, Pt. 2.) Price, 40 cents.
Hawks and Owls from the Standpoint of the Farmer. (Biological Survey Circular 61.) Price, 5 cents.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Secretary of Agriculture	HENRY C. WALLACE.
Assistant Secretary	C. W. PUGSLEY.
Director of Scientific Work	E. D. BALL.
Director of Regulatory Work	
Weather Bureau	CHARLES F. MARVIN, *Chief.*
Bureau of Agricultural Economics	HENRY C. TAYLOR, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Bureau of Plant Industry	WILLIAM A. TAYLOR, *Chief.*
Forest Service	W. B. GREELEY, *Chief.*
Bureau of Chemistry	WALTER G. CAMPBELL, *Acting Chief.*
Bureau of Soils	MILTON WHITNEY, *Chief.*
Bureau of Entomology	L. O. HOWARD, *Chief.*
Bureau of Biological Survey	E. W. NELSON, *Chief.*
Bureau of Public Roads	THOMAS H. MACDONALD, *Chief.*
Fixed Nitrogen Research Laboratory	F. G. COTTRELL, *Director.*
Division of Accounts and Disbursements	A. ZAPPONE, *Chief.*
Division of Publications	JOHN L. COBBS, Jr., *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*
States Relations Service	A. C. TRUE, *Director.*
Federal Horticultural Board	C. L. MARLATT, *Chairman.*
Insecticide and Fungicide Board	J. K. HAYWOOD, *Chairman.*
Packers and Stockyards Administration *Grain Future Trading Act Administration*	CHESTER MORRILL, *Assistant to the Secretary.*
Office of the Solicitor	R. W. WILLIAMS, *Solicitor.*

This bulletin is a contribution from—

Bureau of Biological Survey	E. W. NELSON, *Chief.*
Division of Food Habits Research	W. L. MCATEE, *In Charge.*

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1923