

FOOD HABITS AND FEEDING BEHAVIOR OF THE WHITE-EYED VIREO

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THE purposes of this paper are to describe and discuss the contents of the stomachs of 67 White-eyed Vireos (*Vireo griseus*) and to report field observations bearing on the food habits and feeding behavior of that species.

An interest in the White-eyed Vireo led Nolan to ask for the material in the food habits collection of the Fish and Wildlife Service of the United States Department of the Interior, when that collection was distributed to biologists. The Service kindly granted this request in 1957. The support of the Graduate School of Indiana University, whose generosity is gratefully acknowledged, made possible the participation of Wooldridge, who is responsible for the identifications of the stomach contents. We solicited and received from Dr. W. L. McAtee helpful advice on methods.

STOMACH CONTENTS

The material.—Of 82 stomachs in the collection, 67 were full, or virtually full, of food capable of being identified and measured as to volume. Eleven of the remaining stomachs held matter too comminuted to reveal more than an occasional identifiable structure, and the other four specimens were empty. Three of these last four were collected at 11 PM on 30 April at Washington, D.C., and were presumably the stomachs of birds killed in nocturnal migration. Only the contents of the 67 stomachs referred to first above will figure in the rest of this report.

Distribution of collection dates through the year is uneven. Only April (16 specimens), May (23), and June (9) provide more than three stomachs, but all months except November are represented. The states in which birds were taken, and the numbers collected, are North Carolina (15), South Carolina (15), Florida (13), Georgia (10), Texas (4), Kentucky (2), Virginia (2), Alabama (1), District of Columbia (1), Kansas (1), Maryland (1), Tennessee (1), and West Virginia (1). Thus, 79 per cent of the material comes from four states in the southeastern corner of the range of the White-eyed Vireo in the United States; indeed, only about 7 per cent is from localities outside the southeast, and none is from the north. Four birds had been designated immature; and of 39 adults which had been sexed, 26 were males. If there were dietary preferences associated with age or sex, they were not apparent.

Methods.—Methods of determining bulk followed procedures described by Martin (1949). In most cases volume could be ascertained with reasonable

accuracy by noting the displacement of water in graduated glasses. The advantages of the volumetric method as the primary means of estimating the stomach contents of birds have been set forth by McAtee (1912), who also recognized the additional value of counts of the frequency with which items occur. Table 1, which presents both volumetric percentages and frequency counts, is adapted from tables used by Jones (1940) in his study of the American Coot (*Fulica americana*). Unfortunately, Chapin's (1925) report of the food habits of vireos, although his study included 229 stomachs of the White-eyed Vireo, is somewhat general in its presentation of monthly proportions of items in the diet. We, on the other hand, have felt it undesirable to try to arrive at annual averages for various foods, as Chapin did, because most months are inadequately represented in our collection. Nevertheless, certain comparisons of the results of this study and of Chapin's are possible and are advanced below.

To indicate the volume of a stomach of this vireo we have selected ten stomachs which appeared to us to be typical in size and in contents. The volumes of these ten varied between 0.20 and 0.29 ml and averaged 0.24 ml. These figures may be low, for we have no assurance that the material, which was stored dry, resumed its natural size when we soaked it in 70 per cent alcohol.

Discussion.—Plant material consisted of hard undigested seeds and of a few fragments of seeds. We could not identify these and felt that the circumstances did not warrant submitting them to others. Seeds ranged in diameter to a maximum of about 7 mm, and the numbers in a single stomach varied between one and 13 (average 5). It will be seen that the volumes we assign to vegetable material may sometimes be low, because they do not include any fruit which may have been present with the seeds. The distribution of seeds, by month, in the sample indicates that some vegetable matter is eaten throughout the year, although there was none in the 23 stomachs collected during May. The volume of plant food in autumn and winter cannot be estimated from our scanty material for those seasons, but its importance as compared to its role in spring and summer is suggested: Eight of 11 specimens from October through March contained seeds, whereas only five of 56 stomachs from April through September did so. Chapin's data do not seem to disagree substantially.

Lepidoptera formed much the largest element of the animal food, comprising 46 per cent of the total material in the 48 stomachs from April, May, and June, and little or no less of that from other seasons. (Percentages in this paragraph refer only to the three spring months just mentioned. These percentages are averages of the monthly averages. That is, it seems preferable to assume that the diet may change from month to month and that the sample for

Kind of food	January	Feb- ruary	March	April	May	June	July	August	Sep- tember	Octo- ber	De- cember	
	3 stom- achs	2 stom- achs	2 stom- achs	16 stom- achs	23 stom- achs	9 stom- achs	2 stom- achs	3 stom- achs	3 stom- achs	3 stom- achs	1 stom- ach	
	% ¹	No. ²	%	No.	%	No.	%	No.	%	No.	%	No.
Asilidae					2	1						
undetermined		x 1		x 2	5	3	1	1		7	1	x 1
Hymenoptera												
Tenthredinidae				1	1	x 1						
Formicidae				1	1	1	1					
undetermined		x 1		2	3							
Unidentified	17	125	237	213	814	1911	6		15	210	317	2
Eggs, probably insect	2	1		1	2	3	5	4	2	5	2	1

¹ Volumetric percentage.

² Number of stomachs in which found.

³ Numbers in boldface indicate totals.

x=less than one per cent of the indicated material.

*All stomachs contained insects.

each of the three months is representative, rather than to assume no variation from one month to another, and to average the 48 stomachs as one unit.) Butterflies and moths accounted for only 7 per cent of the lepidopterons; the rest were caterpillars. Chapin's specimens, collected throughout the vireo's range, yielded a smaller proportion of this order; maximum consumption was about 38 per cent, in June, and the annual average was about 30 per cent. In our analysis, beetles ranked second, spiders third, and Hemiptera-Homoptera fourth during the spring months; respective percentages for these orders were 16, 8, and 6. Chapin attributes much greater importance to Hemiptera-Homoptera, which placed second in his study with an annual average of nearly 20 per cent and a spring average of apparently about 30 per cent. It is possible but unlikely that the gap between Chapin's figure and ours might be considerably smaller if we had not had 13 per cent unidentifiable fragments in our sample. Beetles ranked third with Chapin's White-eyed Vireos with a percentage in spring comparable to ours, whereas spiders were an unimportant component of his. Other respects in which our analysis differed notably from Chapin's were the insignificance of three major orders of insects as food of our vireos, namely Orthoptera, Diptera, and Hymenoptera; the frequency of insect eggs in ours (sometimes as many as 100 in a stomach); and the occurrence of May flies in our sample. One of our birds, taken in Florida in February, had ingested 15 per cent fine sand.

FIELD OBSERVATIONS

All of the observations reported in this section were made by Nolan at Bloomington, Indiana. Descriptions of the habitat of the White-eyed Vireo

near Bloomington have appeared in earlier papers (Nolan, 1955, 1960); the bird occupies typical scrub growth here, perhaps somewhat drier than that described for it in other areas (Bent, 1950).

Arrival dates at Bloomington for eight years between 1952 and 1960 ranged from 17 to 27 April and averaged 20 April. Vegetation at this period retains much of the gross aspect of winter, although leafing out and flowering of some trees has usually begun. Insects, except for a few dragonflies, grasshoppers, and butterflies, are inconspicuous. An idea of the relative meagerness of the supply of animal food available to the White-eyed Vireo may be indicated as follows: On 24 April 1956, on a sunny afternoon when the temperature was about 65 F, a net was swept 55 times through vegetation from 1 to 10 feet in height, in a field inhabited by this vireo. These sweeps yielded two spiders, about 35 homopterons (Chermidae) 2.5 mm long, a neuropteran, and nine small flies. On 22 April 1960, in mid-afternoon with the temperature about 80 F, vigorous beating of five low tree branches just beginning to leaf out knocked a somewhat larger quantity of material onto a sheet. The collection included items comparable to those above but contained also three or four additional spiders, a large pentatomid, a caterpillar about 20 mm long, and two lady beetles.

The last White-eyed Vireos leave Bloomington in October. Four dates of observation believed to mark the end of the bird's stay varied between 3 and 8 October, averaging 6 October. By this date scrub vegetation is usually extremely dry and much reduced by the falling or withering of leaves. We believe that the supply of insects on the vegetation at this time is correspondingly diminished.

White-eyed Vireos feed from the ground to high treetops. The greatest height at which they have been noted is 50 feet, with a number of records of birds as high as 25 and 30 feet. Usually, however, vireos at these heights are singing males which spend little time foraging between their frequent songs. Perhaps 90 per cent of the food of the species is gathered in trees and shrubs at elevations of from 2 to 20 feet, an observation which applies to adults, to independent young, and to family groups. The high proportion of caterpillars in the diet indicates that the bird spends much time foraging among leaves, but in the field observations here reported there has seemed to be an equal concentration on bare branches, that is, on those parts of the limbs nearer the trunks. No preferences for radial or tangential courses through the trees have been detected; foraging vireos proceed in, out, and around a tree or bush, or through it to another, and also make vertical movements.

Progress during feeding is rather slow, deliberate, and steady, as the vireo hops or flies from a few inches to a foot or more at a time. The linear distance

covered by a color-banded female foraging steadily at heights of 3 to 10 feet through a clump of sumacs (*Rhus* sp.) was measured as 15 yards in 10 minutes, but this rate is slower than usual. A good many movements involve little or no change of position of the feet; the vireo perches for one or two seconds while peering at a leaf or branch, then abruptly shifts its head or the long axis of its body to face another direction. This peering about is quite noticeable. For example, once a male was observed as it searched along a sassafras (*Sassafras albidum*) branch 4 feet high. It regularly looked below it toward the herbaceous plants of the field cover. Spying a butterfly, apparently a Pearl Crescent (*Phyciodes tharos*), on the ground, the bird descended, caught the insect, returned to the branch, and ate it wings and all. Possibly even more frequently White-eyed Vireos look for food above them and then fly up and hover while they take items from the undersides of leaves or branches.

Hovering is rather frequent, as is chickadee-like hanging from terminal leaf clusters or from small drooping branches. Both adults and young readily hang upside down in order to seize food. On one occasion an immature bird was seen in this position gathering white fruits from a cluster on a small dogwood (*Cornus* sp.) shrub. Another habit of interest is the use of the foot to hold unmanageable food objects. Among the items seen held in this way have been a spider egg case which a male was having great difficulty opening, as well as a brown moth and the Pearl Crescent butterfly mentioned above.

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