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FOODS OF EASTERN BLUEBIRD NESTLINGS IN NORTHWEST TENNESSEE

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ABSTRACT

A study of the foods of nestling Eastern Bluebirds (*Sialia sialis*) was conducted on an Obion County farm in 1974 and 1975. Adults were observed feeding nestlings in nest boxes attached to observation blinds. Primary foods were caterpillars, grasshoppers, spiders, and crickets. The availability of food was determined by periodically checking plots on the study area; potential food items increased in number and size from April through September. Both male and female parents fed nestlings, but the male made fewer deliveries during the latter part of the nestling stage.

INTRODUCTION

Studies of the feeding habits of Eastern Bluebirds (*Sialia sialis*) include reports by Forbes (1880), Beal (1915), and Judd (1900) based on the examination of stomach contents. A recent report on nestling foods (Pinkowski, 1974a) was based on observations of adults feeding nestlings, both in captivity and in the wild, for many hours over a period of three years in Michigan. As part of a continuing study of the ecology of bluebirds near the geographic center of their range, this study deals with the abundance of potential food items and their consumption by nestling bluebirds.

METHODS AND MATERIALS

The study area, a 20 ha cattle farm in Obion County, Tennessee, consisted of well-drained, rolling hills with four small (0.5-2.0 ha) patches of woodland. Fescue (*Festuca elatior*), lespedeza (*Lespedeza striata*), and white clover (*Trifolium repens*) were the most common pasture plants. Bluebirds were common permanent residents; most nests were in nest boxes which had been available in the study area since 1958.

Two plywood observation blinds 1.2 m long, 0.6 m wide, and 1.5 m high were erected on the study area in December 1973. A nest box (cavity approximately 12 x 12 x 20 cm) was attached to one end of each blind. An observation cone extended into the blind from an opening (10 x 10 cm) in the back of the next box. The large end of the cone was open and was secured to the nest box; the small end of the cone was covered except for a 1 cm diameter hole through which the nest could be viewed. This arrangement allowed observation of activities in the nest but prevented the bluebirds from seeing into the blind. An entering adult normally perched in the entrance (3.8 cm diameter) and little light entered. A 3 cm hole was cut in the roof of the next box to increase visibility; this hole was covered with a thin, translucent sheet of plastic to block direct sunlight and rain.

To measure food availability during the nesting season, 11 plots (0.6 x 0.6 m) were studied. The plots were selected from areas where bluebirds had been observed gathering food for nestlings. Although all of the plots were in grassland, each plot was unique; some plots were on ridges, some were in valleys, and others were on variously facing slopes. Each plot was surveyed 8 times in 1974 and 7 times in 1975. All plot surveys were made during midday on clear days, and all plots were surveyed in rapid sequence to assure reasonably constant environmental conditions. During a survey, each plot was inspected for 3 minutes for items that could be used for bluebird nestling food. Each potential food item was identified in the field, and its length was measured or estimated.

RESULTS

During 1974 three nests were observed for 112.05 hours, and in 1975 three nests were observed for 32.40 hours. Food items most frequently delivered to young were caterpillars, grasshoppers, spiders, and crickets (Table I). In addition to these primary foods, adults delivered moths, cherries, horseflies, a variety of beetles, millipedes, grubs, earthworms, termites, and a number of small items which I could not identify. The largest item delivered was a skink (probably *Eumeces laticeps*) approximately 10 cm in length; it was promptly swallowed by a fully grown nestling. Sometimes wings and appendages were removed (by battering the items against limbs), but usually all appendages were still attached to the food items when they were delivered to the young. All items were swallowed without difficulty after the bluebirds were about 10 days old, but during their first 10 days nestlings frequently had to struggle to swallow some of the larger items, particularly Orthoptera with appendages.

TABLE 1: *Food items delivered to nestling bluebirds.*

Date	Observation time (hours)	Number of items delivered	Grasshoppers	Crickets	Spiders	Caterpillars	Moths	Other*
May	13.5	140	7.9** (11)***	10.7 (15)	5.7 (8)	58.6 (82)	2.9 (4)	14.3 (20)
June	70.5	546	22.2 (121)	11.9 (65)	17.6 (96)	21.1 (115)	4.0 (22)	23.3 (127)
July	27.5	168	27.9 (47)	20.2 (34)	25.0 (42)	17.3 (29)	0.0 (0)	9.5 (16)
August	33.0	235	27.7 (65)	19.6 (46)	13.6 (32)	19.6 (46)	0.0 (0)	19.6 (46)
Totals	144.5	1089	22.4 (244)	14.7 (160)	16.3 (178)	25.0 (272)	2.4 (26)	19.2 (209)

* Includes less numerous items and those not identified.
** Percentage of monthly total.
*** Number delivered.

During the first three days following hatching, nestlings received slightly smaller food items than during the remainder of the nestling period (Fig. 1A). The size of nestling food items increased gradually, but with considerable variation. The role of the male declined gradually throughout the nestling period (Fig. 1B).

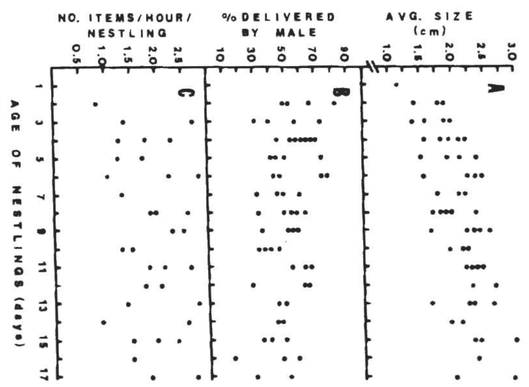

FIG. 1. *Average size of food items delivered to nestlings, percentage of food items delivered by the male parent, and daily variation in the rate at which food items were delivered to nestlings.*

Feeding rates, expressed as the number of food items a nestling received each hour, did not show any pattern of increase or decrease during the nestling period. Fig. 1C, which is based on 107.55 hours of observations of broods of four, shows the variation which existed. Young were usually fed several items shortly after dawn; during the remainder of the day, feeding periods and periods of inactivity alternated as the adults rapidly fed the young and then failed to appear for periods of 30-60 min.

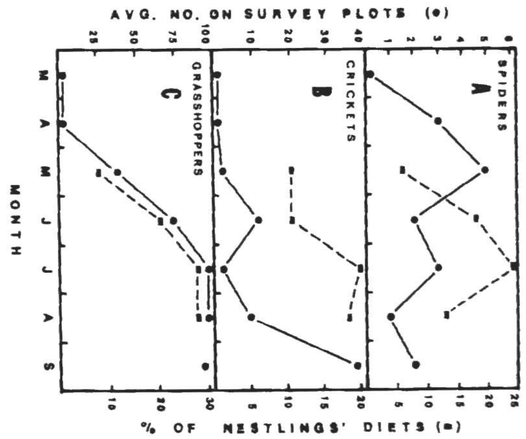

FIG. 2. *Monthly comparisons of the abundance of three major bluebird food items on survey plots and the occurrence of these foods in the diets of nestling bluebirds.*

Adults normally delivered one food item per trip. On only five trips, of 1089, did I observe two or more

items in the bill of an adult. Three of these trips involved termites which were apparently swarming nearby. Adults appeared to feed the nestling which stretched highest and opened its beak widest. Young which were gorged still responded by gaping when a adult appeared with food. However, if the food item was placed in the mouth of such a nestling, it could not swallow and the adult quickly removed the item and placed it in the mouth of another young. Following a period of intense feeding, all of the young were usually satiated and none could swallow additional items; in such cases the adults usually swallowed the item after several futile attempts to feed it to the young.

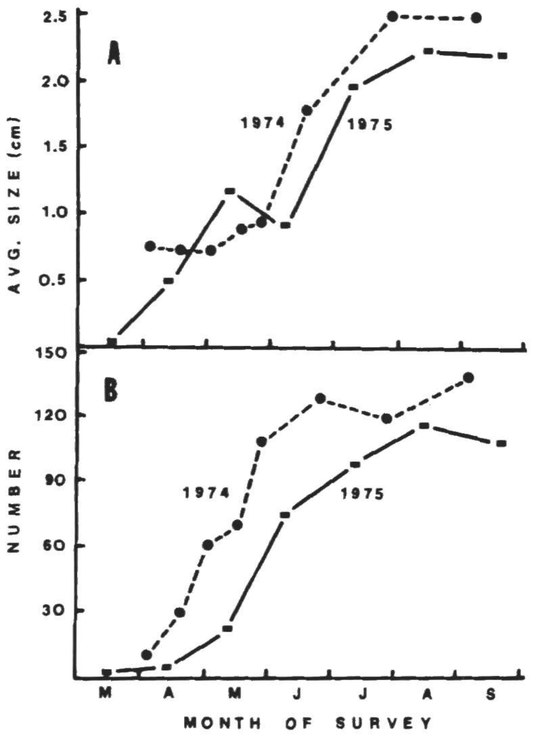

FIG. 3. *Total number and average size of food items from all plots surveyed in 1974 and 1975.*

The type of food delivered to the nestlings did not vary with the age of the young, with the possible exception of the first 2 or 3 days when frequently, but not invariably, small spiders were fed. If the female was brooding small nestlings and the male delivered a large item, such as a grasshopper, the female accepted the item and swallowed it, without attempting to feed the young. Smaller items, however, were transferred from the male to the brooding female to a nestling.

Fig. 2 compares the monthly abundance of three major food items and their respective roles in the diets of nestlings. Fig. 3 shows the total number of the mean size of potential food items observed on all plots for each survey during 1974 and 1975. Table II lists, according to taxa, the food items found.

TABLE II: *Taxa and frequency of food items on survey plots.*

Item	1974 No.	1974 %	1975 No.	1975 %
Arthropoda				
Insecta				
Orthoptera				
Grasshoppers	447	68.6	319	74.2
Crickets	58	8.9	66	15.4
Misc.	10	1.5		
Homoptera				
Leafhoppers	47	7.2	6	1.4
Coleoptera	14	2.1	6	1.4
Diptera	8	1.2	13	3.0
Hymenoptera				
Ants	10	1.5	2	0.5
Misc.	12	1.8	3	0.7
Hemiptera	1	0.2		
Lepidoptera				
Adults	3	0.5	2	0.5
Caterpillars	6	0.9	1	0.2
Arachnida				
Spiders	30	4.6	11	2.6
Annelida				
Earthworms	1	0.2	1	0.2
Unidentified	5	0.8		
Total	652	100.0	430	100.1

Discussion

The only recent major study of the food habits of bluebirds is that of Pinkowski (1974a). He found food of nestlings to consist primarily of Lepidoptera (adults and larvae) 36.0%, Orthoptera (primarily crickets and grasshoppers) 25.6%, spiders 11.3%, and beetles 11.06%; many other items from various taxonomic groups were also consumed. The major difference between results of this study and those of Pinkowski (1974a) is in the number of Orthoptera and Lepidoptera delivered. In both studies these two groups were the most important food items, but I observed Orthoptera being fed more frequently (37.1%) than Lepidoptera (27.4%), almost the converse of Pinkowski's (1974a) results. Pinkowski (op. cit.) saw many more beetles, earthworms, and snails being delivered; I did not observe snails being fed. Pinkowski (op. cit.) suggested that snails and millipedes might supply calcium to the nestlings and I did observe millipedes being delivered on several occasions. Judd (1900) found primarily beetles, Orthoptera, Lepidoptera, spiders, and a few snails in the stomachs of nestling bluebirds.

My observations of an adult bluebird feeding a vertebrate (skink) to a nestling is apparently unique. However, adult bluebirds are known to occasionally eat vertebrates. Beal (1915) mentioned the presence of lizard and frog bones in the stomachs of bluebirds, but these birds were apparently adults; Flanigan (1971) observed an adult bluebird kill and eat a snake and Pinkowski (1974b) observed a bluebird kill and consume a shrew.

Beal (1915) found the primary animal foods of adult bluebirds to be Orthoptera (22.01%), beetles (20.92%), Lepidoptera (10.48%), spiders (4.37%), and ants (3.48%); additional items included Hemiptera, millipedes, earthworms, lizards and tree frogs. Plant foods made up a total of 32% of the diet of the adults and consisted mainly of fruits and seeds (Beal, 1915). Plant foods were consumed primarily during the winter months. The type of food items delivered by adults to nestlings does not differ greatly from the normal diet of the adults with the exception of the greater number of beetles in the adult diet.

In most respects my results and those of Pinkowski (1974a) are similar. We both observed that shortly after hatching, young are more likely to be fed small prey, especially spiders, and that the male makes fewer trips to the nest in the latter part of the nestling stage.

However, some differences do exist between Pinkowski's (op. cit.) results and mine. Pinkowski (op. cit.) found an increase in the rate of feeding as the nestlings grew; my data do not show an increase in the rate of feeding, but they do show a general increase in the size of the food delivered (Fig. 1A). Perhaps the larger prey compensated for the increased requirements of the nestlings on my study area. Pinkowski (op. cit.) observed that frequently two or more items per trip may be delivered to young after the tenth day; I did not observe any increase in the rate of delivering two or more items per trip. In fact, I observed delivery of more than one item per trip so infrequently that I believe it to be of rare occurrence in my study area. Pinkowski (op. cit.) stated that feeding of nestlings was infrequent early in the morning but peaked in mid-morning and at dusk. I found high feeding rates early in the morning followed by a mid-morning lull. Possibly the warmer early morning temperatures in Tennessee permit more efficient bluebird feeding on active insects, thus accounting for the differences.

Neither Judd (1900), Beal (1915), nor Pinkowski (1974a) specifically mentioned finding horseflies (*Diptera: Tabidae*) in the diets of nestling or adult bluebirds, although Beal (1915) and Pinkowski (1974a) noted that Diptera are taken but rarely. My few observations of horseflies being fed to nestlings all occurred as a herd of 12-15 cattle grazed near (i.e., within 100 m) the nest I was observing. I did not observe the method used to capture these insects. I suspect that, as in most predator-prey situations, the less fit individuals were preyed on first. If this was true the bluebirds were conceivably feeding on horseflies that had received a sublethal dose of pesticide from the surface of the cattle which were frequently sprayed with insecticide.

My determination of potential food item abundance (Figs. 2 and 3B) was not designed to give a precise measure of the number of items present. Instead, the surveys were designed to indicate the seasonal trends. Van Hook (1971) studied an East Tennessee grassland ecosystem and prepared a detailed analysis of the arthropod population; his results show the same general trends that are indicated by my data.

Food items were relatively scarce during the time when bluebirds were laying their first clutches of the year (late March-early April). This would seemingly place restrictions on the activities of the adults. However, as will be discussed in later papers, few of the activities of the adults during the first nesting period appear to have been restricted, and it was during this period that the largest clutches were laid. These observations suggest that food supplies in Tennessee, even during late March and early April, are not low enough to curtail reproductive activities of the adult bluebirds.

The variation in consumption of grasshoppers parallels my counts on survey plots (Fig. 2C). The survey plot counts of crickets and spiders do not show the trends I observed in nestling food deliveries. That the numbers and kinds of food items delivered to nestlings were not in the same proportions as my plot counts is not unexpected. Bluebirds have keen vision (Preston and McCormick, 1948) and may concentrate on a certain type of prey after first encountering one. For example, each adult frequently brought the same type of item on successive trips, and sometimes 8 or 10 similar items were delivered before another variety was captured. Tinbergen (1960) referred to the formation of specific searching images to explain such behavior in tits (*Parus* sp.) Consequently, certain types of abundant prey items may have been temporarily ignored in favor of other prey. In general, bluebirds appeared to be opportunistic feeders: that is, they delivered to the nestling the most readily available food items of the appropriate size that matched their specific searching image.

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