Notes on the Food Habits of the Long-tail Salamander, Eurycea longicauda, and the Cave Salamander, Eurycea lucifuga

Wynn W. Cudmore
Indiana State University, Terre Haute, Indiana 47809
and
David Rubin
Department of Biology
Central State University, Wilberforce, Ohio 45384

Introduction

It is generally believed that adult salamanders take any prey of appropriate size (Hairston 1949) and that their diets are determined largely by availability of food items (Hamilton 1932). There are few quantitative studies available on the food habits of the long-tail salamander, *Eurycea longicauda*, and the cave salamander, *E. lucifuga*. Minton (1972) reported small terrestrial insects and spiders as the major foods of *E. longicauda* in Indiana, with other arachnids, centipedes, snails and annelids eaten occasionally. Anderson and Martino (1967) described the food habits of *E. longicauda* as being "determined both by availability and preference with some foods taken in proportion to their abundance while others were either not eaten or taken at far below their relative abundance." Coleoptera, spiders, Hymenoptera and isopods were the major foods of individuals from pond margins. Hutchinson (1958) reported heleomyzid flies to be the major foods for small samples of both *E. longicauda* and *E. lucifuga* from in or near caves. Neither species showed predilection to a particular type of food. Peck (1974) provided detailed data on the foods of *E. lucifuga* and found this species to feed on a broader range of food items than *Plethodon glutinosus* in caves. Mycetophilid and heleomyzid flies were the major foods.

The purpose of the present study is to provide additional quantitative information on the food habits of these two species and to investigate seasonal and size relationships.

Methods

Indiana specimens were either collected in Harrison and Crawford counties or taken from the Indiana State University herpetology collection. Museum specimens represented collections primarily from west-central and southern Indiana. All Ohio specimens were collected 2 miles NE of Xenia, Greene County. Salamanders were preserved in 10% formalin and later transferred to alcohol. Snout-vent length was recorded for each individual. Stomachs were removed, examined in water, and their contents were identified using a dissecting microscope. Percent volume for each food was estimated. Data were then summarized as percent volume and percent frequency for Indiana and Ohio separately.

Results and Discussion

Isopods (24.3% volume), spiders (14.3% volume) and adult Diptera (9.8% volume) were the major foods of Indiana longtail salamanders (Table 1). Although Collembola occurred in 34.4% of those stomachs containing food, their contribution to total volume was relatively small at 4.0%. Isopods were terrestrial in nature, spiders were mainly small to medium-sized lycosids and most dipterans were members of the Acalyptratae. Gastropods were represented by small snails and

TABLE 1. *Stomach contents of Eurycea longicauda from Indiana. 80 examined, 61 with food; SV range = 23-61 mm, mean = 46.1, SD = 8.36.*

Food	% Volume	% Frequency
Isopoda	24.3	39.3
Araneae	14.3	36.1
Diptera (adult)	9.8	21.3
Gastropoda	6.8	18.0
Coleoptera (adult)	6.6	18.0
Lepidoptera (larvae)	5.8	9.8
Collembola	4.0	34.4
Coleoptera (larvae)	3.7	13.1
Homoptera (adult)	3.2	9.8
Hemiptera (adult)	2.4	11.5
Diptera (larvae)	2.0	4.9
Orthoptera	2.0	4.9
Hymenoptera	1.7	11.5
Ephemeroptera	1.6	1.6
Diplopoda	1.6	3.3
Earthworm	1.5	1.6
Chilopoda	0.7	4.9
Shed skin	0.7	1.6
Lepidoptera (adult)	0.4	3.3
Pseudoscorpion	0.1	1.6
Unidentified insect	4.6	11.5
Vegetation	1.2	11.5
Detritus	1.1	13.1
	100.1	

slugs (Limacidae). Ohio longtail salamanders (Table 2) fed primarily on Collembola (20.0% volume), adult Diptera (14.5% volume), isopods (11.3% volume) and

TABLE 2. *Stomach contents of Eurycea longicauda from Greene County, Ohio. 81 examined, 72 with food; SV range = 23-57 mm, mean = 41.3, SD = 9.31.*

Food	% Volume	% Frequency
Collembola	20.0	54.2
Diptera (adult)	14.5	27.8
Isopoda	11.3	22.2
Diptera (larvae)	10.8	19.4
Araneae	7.8	18.1
Gastropoda	4.0	6.9
Earthworm	3.6	6.9
Coleoptera (adult)	3.4	6.9
Shed skin	3.1	4.2
Coleoptera (larvae)	2.6	8.3
Orthoptera	2.5	2.8
Homoptera	2.0	9.7
Chilopoda	1.4	1.4
Acarina	1.2	5.6
Plecoptera	1.0	1.4
Hymenoptera	0.9	5.6
Trichoptera (larvae)	0.9	1.4
Hemiptera	0.6	4.2
Unidentified	4.2	11.1
Vegetation	1.9	6.9
Unidentified insect larva	1.4	1.4
Unidentified insect	1.1	4.2
	100.2	

TABLE 3. *Stomach contents (in % volume) of Eurycea longicauda from Indiana categorized by season.*

Food	April-May (N = 21)	June-Aug (N = 25)	Sept-Nov (N = 15)
Araneae	16.5	15.3	9.5
Isopoda	15.0	17.4	48.7
Diptera	21.1	13.1	1.3
Coleoptera	10.5	7.2	— —
Gastropoda	9.5	8.6	0.2
Homoptera	6.5	2.2	— —
Collembola	5.8	3.2	2.6
Coleoptera (larvae)	5.2	1.8	4.7
Diptera (larvae)	5.0	0.8	— —
Lepidoptera (larvae)	2.4	7.0	8.7
Diplopoda	— —	— —	6.3
Orthoptera	— —	5.0	— —

dipterous larvae (10.8% volume). Collembola occurred in over half of those stomachs containing food and unlike Indiana specimens, contributed a major portion of the total volume. Dipterans were mostly very small and included members of the families Phoridae, Mycetophilidae, Tipulidae and Culicidae. Coleoptera from both Indiana and Ohio were primarily staphylinids.

For *Eurycea longicauda*, items accounting for 5% or more of total volume in at least one season are categorized by season for Indiana (Table 3) and for Ohio (Table 4). In both collections adult Diptera were important in spring and summer but decreased dramatically in fall. Collembolans were approximately twice as important in spring as in summer or fall. Perhaps they become less important as a wider variety of foods becomes available. Spiders are the only item that maintained a relatively high importance throughout the year for both collections. Dipterous larvae were approximately twice as important in fall as in other seasons for Ohio individuals. Although Indiana *E. longicauda* showed strong seasonal utilization of isopods (primarily fall) and gastropods (spring-summer), the same trends were not found in Ohio.

Feeding habits of larger longtail salamanders tended to be more diverse than those of smaller individuals. For large Ohio *E. longicauda* (SV 43-57 mm), there were 17 categories of identifiable items and the top 6 accounted for 66.0% of

TABLE 4. *Stomach contents (in % volume) of Eurycea longicauda from Green County, Ohio, categorized by season.*

Food	April (N = 33)	June (N = 16)	Sept-Oct (N = 23)
Collembola	28.6	11.0	13.9
Diptera	18.6	19.5	5.0
Isopoda	14.5	3.1	12.2
Diptera (larvae)	8.5	7.5	16.5
Shed skin	6.7	— —	— —
Earthworm	6.4	3.1	— —
Araneae	6.2	10.0	8.5
Coleoptera	0.9	5.9	5.2
Coleoptera (larvae)	— —	8.5	2.2
Orthoptera	— —	6.3	3.5
Gastropoda	— —	— —	12.4
Homoptera	— —	— —	6.3

total volume, while there were 13 categories of identifiable items taken from small Ohio *E. longicauda* (SV 23-37 mm) with the top 6 accounting for 79.1% of total volume. Although few Indiana individuals were small, a single food category made up 100% of the total volume in 6 of 8 containing food. Only 4 of 43 (9.3%) of large salamanders contained a single category of food. Shed skin made up only a small portion of total volume but was found only in larger salamanders (SV = 47,48,52, and 55 mm). Whitaker and Rubin (1971) found shed skin to be more frequent in larger size classes of *Plethodon jordani*. They proposed that although smaller salamanders would gain more by consuming shed skin since it would be a larger proportion of their total mass, it may be too large for them to consume.

Sixteen *E. longicauda* larvae, all taken in June, were examined. Eleven contained food. Chironomid larvae were the major food at 87.3% volume while coleopterous larvae and Collembola were less important. Caldwell and Houtcooper (1973) found chironomid larvae to be the major food item of *Eurycea bislineata* larvae in March and August from Vigo County, Indiana.

Cave salamanders were collected primarily from localities in Harrison and Crawford counties in Indiana. Most were collected from the twilight zone of caves; however, some were from open limestone areas. Forty cave salamanders were examined, 15 of which contained no food. The data for the remaining 25 are given in Table 5. Adult dipterans (28.7% volume), spiders (18.5% volume), and Coleoptera (18.1% volume) were the major food items. Dipterans were represented by acalypterate families, and spiders were mostly lycosids. Cave salamanders showed no seasonal shift in food habits as all major foods were well represented in each season. While isopods and springtails were the most important foods for Indiana and Ohio *E. longicauda* respectively, these foods were relatively unimportant in this sample of *E. lucifuga*. Adult Diptera and spiders were the only items that contributed significantly to the foods of both species. In a study of the foods of *Eurycea bislineata*, Hamilton (1932) found Coleoptera, spiders, isopods,

TABLE 5. *Stomach contents of Eurycea lucifuga from Indiana. 40 examined, 25 with food; SV range = 30-71 mm, mean = 56.8, SD = 8.26*

Food	% Volume	% Frequency
Diptera (adult)	28.7	48.0
Araneae	18.5	36.0
Coleoptera (adult)	18.1	28.0
Earthworm	8.0	8.0
Lepidoptera (larvae)	7.8	16.0
Shed skin	3.0	8.0
Hymenoptera	2.6	12.0
Isopoda	2.4	8.0
Orthoptera	2.0	8.0
Chilopoda	2.0	4.0
Diptera (larvae)	1.4	4.0
Collembola	1.0	12.0
Hemiptera (adult)	0.4	4.0
Coleoptera (larvae)	0.4	4.0
Acarina	0.3	8.0
Pseudoscorpion	0.2	4.0
Lepidoptera (adult)	0.2	4.0
Psocoptera	0.1	4.0
Unidentified insect	1.5	16.0
Vegetation	1.4	12.0
	100.0	

mayflies and Diptera to be the major foods. Of these, spiders, isopods and Diptera were important foods of *E. longicauda.*

Indications from the literature and the present study are that *E. lucifuga* feeds primarily on adult Diptera while *Eurycea longicauda* tends to be more versatile in food habits with major foods being quite different in several studies. This likely reflects broader habitat tolerances of *E. longicauda,* but an actual preference for foods on the part of *E. lucifuga* cannot be entirely ruled out at this time.

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