

Food Habits of the Juvenile and Adult Orangebelly Darter, *Etheostoma radiosum*, In Glover Creek, Oklahoma

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The orangebelly darter, *Etheostoma radiosum radiosum*, and benthic macroinvertebrates were collected from Glover Creek, Oklahoma, once each quarter from October 1979 to July 1980. The diet of the orangebelly darter consisted primarily of aquatic insect larvae, especially dipterans, although a wide variety of other organisms were also eaten. Food habits were similar to those of *E. r. cyanorum* in the Blue River. The orangebelly darter appeared to feed selectively. The relative frequency of major food items shifted noticeably between seasons but did not always correspond to the relative abundance of benthic macroinvertebrates in the stream. Juvenile and adult orangebelly darter had significantly ($p \leq 0.05$) different diets except during March 1980.

INTRODUCTION

The orangebelly darter, *Etheostoma radiosum* (Hubbs and Black), occurs only in tributaries of the Red River in southwestern Arkansas and southeastern Oklahoma (1). The only information available on the food habits of the orangebelly darter was collected by Scalet (2) for the Blue River subspecies, *E. r. cyanorum*. Scalet determined that juveniles primarily ate copepods, cladocerans, smaller ephemeropterans and dipteran larvae while adults consumed larger ephemeropterans and dipteran and trichopteran larvae. He also concluded that orangebelly darters were quite selective in what they ate and that juveniles and adults had different feeding habits.

The purpose of this study was to examine the food habits of juvenile and adult orangebelly darters, *E. r. radiosum*, in Glover Creek, Oklahoma. Samples were collected from a single site, once each quarter, from October 1979 to July 1980, in order to examine temporal changes in diet. Benthic macroinvertebrates and darters were collected simultaneously to compare stomach contents with relative availability of prey items.

STUDY AREA

Glover Creek is a tributary of the Little River in McCurtain County, Oklahoma, and has its source in the Beavers Bend Hills subsection of the Ouachita Mountains. The upper reaches of Glover Creek are characterized by mountainous ridges with steep slopes that are heavily forested with oak and pine. The lower reaches are surrounded by low, fertile flatlands.

The sampling site was located on the mainstem of Glover Creek approximately 0.5 km below the confluence of the East and West Forks (Fig. 1). Samples were taken from a narrow, shallow riffle area approximately 30 m long and 15 m wide located just downstream from a low-water concrete bridge. Major substrate types consisted of rubble (65-256 mm) and gravel (2-64 mm) with small boulders (257-1000 mm) interspersed throughout the area. During summer periods of low flow, water willow (*Justica* sp.) became quite dense in shallow areas of the riffle and along the shorelines. A more complete description of Glover Creek is available in Jones (3).

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METHODS AND MATERIALS

Specimens of the orangebelly darter and benthic macroinvertebrates were collected four times, once each quarter, from October 1979 to July 1980. On each occasion, three samples of benthic macroinvertebrates were collected with a circular depletion sampler and about 50 to 60 orangebelly darter specimens were collected with a Smith-Root Type VII backpack electrofishing unit.

Benthic organisms were preserved in the field with 10% formalin and were identified in the laboratory by using keys by Pennak (4), Usinger (5), Edmunds et al. (6), Wiggins (7), and Merritt and Cummins (8). The three samples from each collection were combined and the total number and percent composition for major taxonomic groups were tabulated.

Fish were measured to the nearest millimeter to obtain total length. Scales were removed from the left side of the body above the lateral line and below the dorsal fin and were examined to distinguish juveniles (less than age 1) and adults. The total lengths of juveniles during each quarter were as follows: ≤ 48 mm in October 1979, ≤ 43 mm in January 1980, ≤ 45 mm in July 1980, and ≤ 34 mm in March 1980. In October 1979, age 1 fish were included with juveniles to increase the sample size. Stomach contents were examined with a binocular dissecting microscope and food items identified with the keys mentioned previously. The percent by number for each major taxonomic group found in darter stomachs was tabulated separately for adults and juveniles in each collection. Chi-square tests of independence (9) were used to test the null hypothesis that the diet of the orangebelly darter was independent of age (adults vs juveniles) for each collection.

RESULTS

The major items in the overall diet of the orangebelly darter were aquatic insects and microcrustaceans (Table 1). Dipterans were generally the major food items, with ephemeropterans, plecopterans and trichopterans occurring less frequently. Copepods and cladocerans were relatively frequent in stomachs during October 1979 (19%) and January 1980 (15%). Other insects (Odonates, meglopterans and lepidopterans) and other taxa such as annelids, ostracods and gastropods were eaten in small numbers throughout the year but usually contributed less than 1% of the diet.

E. radiosum fed selectively and exhibited a distinct preference for particular food items. Coleopterans were always very frequent (26-46%) in benthic samples (Table 2) but were relatively rare (< 1%) in the diet. The frequencies of annelids, ephemeropterans,

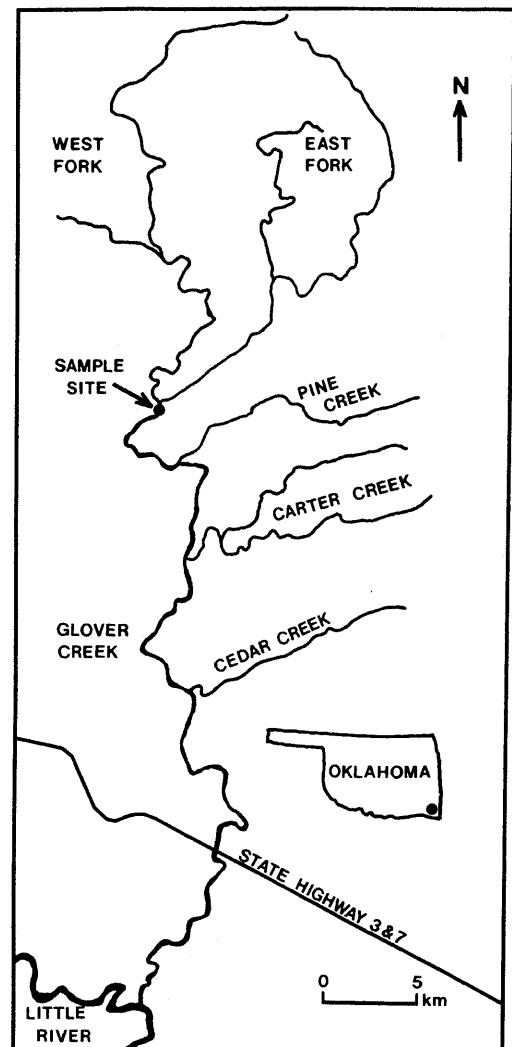


FIGURE 1. Sample site location of Glover Creek, Oklahoma.

TABLE 1. Frequency of various food items in the stomachs of the juvenile (J) and adult (A) orangebelly darter and for both groups combined (T) in Glover Creek, Oklahoma.

Organism	October 1979			January 1980			March 1980			July 1980		
	J	A	T	J	A	T	J	A	T	J	A	T
Insecta												
Ephemeroptera	.01	.02	.02	.01	.02	.02	.32	.29	.31	.22	.15	.20
Plecoptera	.04	.02	.03	.28	.19	.23	.03	.04	.03	.01	.01	.01
Trichoptera	.02	.04	.03	.01	.01	.01	.03	.05	.04	.41	.60	.46
Diptera	.57	.85	.72	.45	.73	.58	.53	.60	.55	.28	.18	.26
Other ¹	<.01	.01	<.01				<.01		<.01	.03	.01	.03
Copepoda	.23	.03	.13	.15	.03	.09	.07	<.01	.05	<.01	<.01	<.01
Cladocera	.11	.02	.06	.09	.02	.06	.01	<.01	.01	<.01	<.01	<.01
Other ²	.01	<.01	<.01	.01		<.01				.03	.03	.03
Number of fish	24	27	51	30	26	56	32	15	47	41	26	67

¹Includes Megaloptera, Odonata, Lepidoptera and Coleoptera.

²Includes Annelida, Gastropoda, Ostracoda, Hydrocarina and Collembola.

TABLE 2. Number (N) and frequency (Freq.) of various macroinvertebrates in samples collected from Glover Creek, Oklahoma.

Taxa	October 1979		January 1980		March 1980		July 1980	
	N	Freq.	N	Freq.	N	Freq.	N	Freq.
Nematoda	117	0.03	2	<0.01	8	<0.01	0	
Annelida	332	0.08	239	0.12	494	0.11	116	0.01
Mollusca	4	<0.01	1	<0.01	1	<0.01	1	<0.01
Acarina	0		0		48	0.01	0	
Crustacea	2	<0.01	3	<0.01	1	<0.01	2	<0.01
Insecta								
Ephemeroptera	768	0.18	340	0.18	679	0.15	2719	0.31
Plecoptera	272	0.06	540	0.28	490	0.11	693	0.08
Odonata	75	0.02	7	<0.01	12	<0.01	52	<0.01
Hemiptera	2	0.01	0		0		1	<0.01
Megaloptera	39	<0.01	25	0.01	55	0.01	114	0.01
Trichoptera	824	0.19	63	0.03	240	0.15	1838	0.21
Lepidoptera	6	<0.01	0		10	<0.01	168	0.02
Coleoptera	1690	0.40	501	0.26	2069	0.46	2752	0.32
Diptera	114	0.03	185	0.10	378	0.08	227	0.03
Total	4235	1.00	1906	1.00	4485	1.00	8686	1.00

and plecopterans were also higher in benthic samples than in the diet. On the other hand, dipterans were infrequent (3 - 10%) in benthic samples (Table 2) but were the major food items (26 - 72%) consumed by the fish.

Preference for particular food items shifted seasonally. Between October 1979 and January 1980, the frequency of dipterans and microcrustaceans in the diet decreased from 72% to 58% and from 19% to 15%, respectively, while the frequency of plecopterans in the diet increased from 3% to 22% (Table 1). Between January 1980 and March 1980, the frequency of ephemeropterans in the diet increased sharply from 2% to 31% while the frequency of plecopterans in the diet decreased from 22% to 3%. From March 1980 to July 1980, the frequency of trichopterans in the diet increased from 4% to 46% while the frequency of dipterans in the diet decreased from 55% to 26%.

Seasonal changes in diet generally followed corresponding changes in the frequency of organisms in benthic samples. However, the sharp increase in the frequency of ephemeropterans in the diet between January and March 1980 occurred even though their frequency in the environment decreased from 18% to 15%.

Juveniles and adults generally ate the same foods but items were taken in different proportions. For example, copepods and cladocerans occurred more frequently in juvenile stomachs (8 to 34%) than in adult stomachs (5%) whereas dipterans (with the exception of July) were more frequent in adult stomachs (60-85%) than in juvenile stomachs (45-57%). Juvenile stomachs had a higher percentage of plecopterans in January 1980 and of ephemeropterans in March 1980 than those of adults (Table 1). These differences resulted in the juvenile and adult orangebelly darter having significantly different ($p < 0.05$) diets during three of the four periods.

DISCUSSION

In general, *E. radiosum* in this area of Glover Creek consumed a wide variety of organisms but tended to select for dipteran larvae. At the same time, they appeared to remain relatively opportunistic. For example, Plecoptera, Trichoptera, and Ephemeroptera were utilized to some degree throughout the year, but the proportion of these items in the diet was greatest during periods of increased abundance.

The only previous study of food habits of the orangebelly darter was on the Blue River subspecies, *E. r. cyanorum* (Scalet 1972). Scalet observed distinct changes in the numbers, volumes, and kinds of food items consumed as the darters increased in size. Younger fish ate copepods, cladocerans, and smaller ephemeropterans and dipteran larvae while older fish consumed larger ephemeropterans, dipterans, and trichopteran larvae. After comparing benthic samples with stomach contents, Scalet concluded that this subspecies of orangebelly darter was selective in feeding.

Since our data were collected at only one location, the results are representative only for this area of Glover Creek and should not be interpreted as representing the entire system. Despite the limited scope of our study, we found that the food habits of *E. r. radiosum* that we collected were very similar to those of *E. r. cyanorum* in the Blue River. An interesting difference is that Plecoptera were not utilized in the Blue River whereas this food item contributed significantly to the diet of the orangebelly darter in Glover Creek. This difference probably results from differences in availability; Scalet did not find Plecoptera in his benthic samples. Scalet also observed that riffle beetle larvae were utilized by fish of all ages in the Blue River while this organism was rarely consumed by orangebelly darter in Glover Creek.

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