

DIETARY PREFERENCES OF THE SLOUGH DARTER, *ETHEOSTOMA GRACILE*, IN CYPRESS SLOUGH, SOUTHWESTERN INDIANA

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ABSTRACT: The diet of the slough darter (*Etheostoma gracile*) was studied in Cypress Slough, a lacustrine ecosystem adjacent to the Ohio River in extreme southwestern Indiana. Ninety-three darters were collected and their stomach contents analyzed. During the spring, the major components of the diet were isopod, copepod, and amphipod crustacea. A shift in the diet to chironomid larvae and copepoda occurred by summer, and a second shift to cladocera, copepoda, and amphipoda was noted in autumn. There was no evidence of dietary competition with the mud darter (*E. asprigene*), which was sympatric with the slough darter during spring.

INTRODUCTION

A few populations of the slough darter, *Etheostoma gracile*, are known to occur in the southwestern corner of Indiana (Grannan and Lodato, 1986), where its habitats include the sloughs, swamps, and slow-moving streams of the Ohio and Wabash drainages. The distribution of this darter is largely limited to the Mississippi Coastal Plain, and populations in central Illinois and Indiana represent the northernmost limit of the species' range (Page, 1983).

Few studies have dealt with the ecology of the fish of southwestern Indiana; most of the papers published to date are faunistic surveys of the area (Kozel, *et al.*, 1981; Schultheis, *et al.*, 1987; Yeager, *et al.*, 1987; Cervonne, *et al.*, 1989) or deal with populations occurring in adjacent states (but see Bandoli, *et al.*, 1991). This is true for the slough darter, as little information other than a life history study (Braasch and Smith, 1967) conducted in Illinois is available concerning its ecology. Because southwestern Indiana is increasingly under the threat of habitat modification and loss, there is a need to establish baseline data on the distribution and natural history of species occurring in the area. As many darters are intolerant of siltation and other environmental disturbances, a number of species have been extirpated from Indiana or have experienced extensive range reductions (Whitaker and Gammon, 1988). Habitat loss due to the drainage of swamps and sloughs adjacent to large rivers has decreased the range of the slough darter (Smith, 1971). The purpose of this study is to report the food habits of the slough darter in Cypress Slough, Posey County, Indiana.

MATERIALS AND METHODS

This study was conducted in Cypress Slough, a swamp 6.5 km southeast of Mt. Vernon, Indiana. The swamp covers 26.3 hectares and is dominated by bald cypress (*Taxodium distichum*) and an extensive growth of buttonbush (*Cephalanthus occidentalis*). The substrate is mostly soft mud covered with fallen leaves, twigs, and other debris. The basin drains an area of approximately 67 km² of agricultural land interspersed with small wood lots.

Darters were collected during three seasons in 1990: 20 March to 20 April (spring); 3 July to 3 September (summer); and 6 November to 20 November (autumn). Shallow areas of the swamp (20 to 30 cm) were sampled with a 1.1 X 1.7 m seine (4 mm mesh). All darters captured, including the sympatric mud darter (*Etheostoma asprigene*), were preserved immediately in 10% formalin and brought to the lab for stomach contents analysis.

Fish were measured (standard length), and the foregut dissected. Stomach contents were identified to genus or lowest practical taxon. Diet composition was calculated from the number of individuals of the various prey types. Percent occurrence (percent of stomachs containing a particular taxon) and percent frequency were used to describe diet components.

Quantitative sampling of the benthos in order to determine the forage baseline was impossible due to the nature of the slough's substrate. Therefore, selectivity indices for prey items could not be determined.

RESULTS

A total of 93 slough darters were collected and examined; 21 during the spring, 40 through the summer, and 32 in autumn. All darters examined had at least one food item in their stomach (Table 1). Standard lengths ranged from 31 to 38 mm in spring (\bar{x} = 35.73 mm), 24 to 32 mm in summer (\bar{x} = 30.2 mm), and 34 to 43 mm in autumn (\bar{x} = 38.81 mm). Changes in both the range and average standard lengths of darters collected represent normal seasonal growth characteristics for this species (Braasch and Smith, 1967).

Isopods were the major food item during the spring (56.5% of the total diet). Amphipods and copepods were also important at this time (15.7% and 18.5%, respectively), while decapods as well as tabanid and chironomid larvae made smaller contributions to the diet. Isopods, amphipods, and copepods each occurred in more than 50% of the stomachs of spring collected slough darters.

Summer diets consisted largely of chironomid larvae (49.6%) and copepoda (43.6%). Darters ate nearly equal numbers of copepods and chironomid larvae, but percent occurrence indicated that only half of the examined darters had selected copepods, while over 90% had selected chironomid larvae (Table 1). Amphipoda were somewhat less important during the summer than in the spring. Heleidae, Libellulidae, and Gerridae made up an almost incidental part of the diet.

Major components of the autumn diet were microcrustacea. Cladocera (44.6%) were the major food item during this period, while copepods (23.6%) contributed

Table 1. Stomach contents of slough darters by season of collection. Percent frequency of food items is followed parenthetically by percentage of stomachs in which the food organism occurred.

Taxa	Spring (N=21)	Summer (N=40)	Autumn (N=32)
Crustacea			
Isopoda, <i>Asellus</i> sp.	56.5 (66.7)	not consumed	2.0 (9.0)
Amphipoda, <i>Gammarus</i> sp.	15.7 (66.7)	4.5 (16.6)	18.2 (44.0)
Decapoda, <i>Palaemonetes</i> sp.	2.8 (13.3)	not consumed	not consumed
Copepoda	18.5 (53.3)	43.6 (50.0)	23.6 (25.0)
Cladocera	not consumed	not consumed	44.6 (50.0)
Ostracoda	not consumed	not consumed	0.7 (3.1)
Insecta			
Diptera, Chironimidae	5.6 (26.6)	49.6 (91.7)	5.4 (16.0)
Ceratopognidae	not consumed	0.8 (8.3)	0.7 (3.1)
Tabanidae	0.9 (6.6)	not consumed	not consumed
Simuliidae	not consumed	not consumed	0.7 (3.1)
Hemiptera, Gerridae	not consumed	0.75 (8.3)	not consumed
Odonata, Libellulidae	not consumed	0.75 (8.3)	not consumed
Coenagriidae	not consumed	not consumed	3.4 (6.2)
Mollusca			
Gastropoda, <i>Physa</i>	not consumed	not consumed	0.7 (3.1)

somewhat less to the diet than in the summer. Chironimid larvae declined in importance, while Coenariinidae, Isopoda, Simuliidae, Ceratopogonidae, Ostracoda, and Gastropoda were occasionally taken. A greater variety of items were consumed by the slough darter in the autumn than in the previous two seasons.

Ten mud darters were collected in March and April (standard length = 41 to 46 mm, \bar{x} = 43.3 mm), and their stomach contents were analyzed. During this period, the diet of the mud darter consisted of isopods (53.5%), decopods (25.1%), gastropods (14.3%), and amphipods (7.1%). No other mud darters were collected over the course of the study.

DISCUSSION

The diet reported here is generally consistent with other studies of the food habits of darters (Page, 1983), although there are some differences from the diet previously reported for the slough darter (Braasch and Smith, 1967). In the Illinois study, chironimid larvae were found to be the most important component of the diet throughout the year, except in May, when ephemeroptera naiads increased in importance. In Indiana, crustacea were the major food item in the spring and autumn, while chironimid larvae were important only during the summer. Also, feeding was

heavy during the spring but became very light from July through September in Illinois, a trend not evident from my data. However, these comparisons should not be overemphasized, since the habitats studied in Indiana and Illinois are different (stream versus slough). The differences may attest to the opportunistic nature of the slough darter or to the presence of a different food base.

Two temporal trends were evident in the diet of *E. gracile*. Between the spring and summer, chironomid larvae and copepoda replaced the isopoda and amphipoda as the major food items. Similar dietary shifts have been reported in other darters (e.g., *Etheostoma asprigene* in Cummings, *et al.* (1984)). This may be a function of abundance, as chironimids may be more plentiful in the summer than in the spring. Unfortunately, this hypothesis could not be tested, as the nature of the slough's substrate made quantitative sampling of the benthos impossible.

The second trend was apparent from summer to autumn, as chironomid larvae were replaced by cladocera as the major component of the diet. The majority of cladocera consumed in the autumn were large and gravid, supporting Braasch and Smith's (1967) comment that food selection is based on size and availability.

Common darter associates of the slough darter are the mud darter (*Etheostoma asprigene*), the johnny darter (*E. nigrum*), and the buntnose darter (*E. chlorosomum*) (Braasch and Smith, 1967; Page, 1983; Cummings, *et al.*, 1984). Other studies have shown that competitive interactions between sympatric darters can affect the diet of these fishes (Hlohowskij and White, 1983; Martin, 1984). The mud darter is a potential competitor of the slough darter in Cypress Slough. However, the selection of larger prey taxa by the mud darter would seem to reduce the potential for competition. No mud darters were captured during the summer or autumn, suggesting that the two species may be temporarily disjunct in Cypress Slough. Since both slough darters and mud darters spawn in the spring and deposit their eggs on submergent plants or debris (Cummings, *et al.*, 1984), the temporary sympatry of the two species may be due to immigration of the mud darter into the study site for spawning. Therefore, competition with mud darters may not be important to the food habits of the slough darter in Cypress Slough.

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