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Age and Growth, Length-Weight Relationships, and Condition Factors of the Greenside Darter from Silver Creek, Kentucky

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Abstract

Data on age and growth were obtained from 203 greenside darters from Silver Creek, Madison County, Kentucky, during February and March 1973. The fish length–scale length relationship was TL = 20.16 + 0.9937 SR. Males were larger than females at all ages, but relative to their respective calculated maximum lengths, females grew more rapidly except during the last year of life. The length–weight relationship was log W = −5.1894 + 3.1199 log L for the combined sexes. Condition factor (K) increased with age, but there was no significant difference between males and females.

Introduction

The greenside darter is a common inhabitant of streams of the Great Lakes, and Mississippi and Potomac river drainages. In Kentucky, the adults are typically found over bedrock in swift, deep riffles, while the juveniles may be found in less violent habitats. It is the largest member of the subgenus *Etheostoma* and characteristically has a complete lateral line, gill membranes broadly connected, frenum well developed, large, expansive pectoral fins, and sides with about 8 double bars, each pair forming a U-shaped figure.

No data on age and growth of the greenside darter are available for Kentucky, and few such data are available for the species from other states. Growth information is often necessary for studies of maturity, mortality rates, and population dynamics. This study provides information on growth, length–weight relationships, age structure, condition factors, and sex ratios of *E. blennioides* in a Kentucky stream. Regional comparisons were made with growth studies on *E. blennioides* in Pennsylvania (Lachner et al. 1950) and New York (Fahy 1954).

Materials and Methods

Two hundred three greenside darters were taken in 5 collections at 3 different stations in Silver Creek, a tributary to the Kentucky River, Madison County, Kentucky, during February and March 1973. All fish were preserved in 10 percent formalin, numbered, measured to the nearest millimeter (total length), weighed to the nearest 0.1 g, and sexed.

Approximately 10 scales were removed from the right side of each darter, below the lateral line, and at the tip of the compressed pectoral fin. At least 4 scales were cleaned with a bleach solution, mounted between glass slides, and examined with a microprojector (80× magnification). The distance from the focus to the anterior margin of the scale and to each annulus was measured to the nearest millimeter along the radius most nearly colinear with the focus, as described by Hile (1954). The identification number of the fish from which the scales were taken was recorded on each slide. All scales were prepared at the same time and read without immediate knowledge of the fish from which they came to prevent bias in age determination because of the size of the fish (Marcy 1969).

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The body–scale relationship was: TL = 20.16 + 0.9937 SR, where TL = total length and SR = anterior scale radius (at 80×). The body scale relationship was linear (r = 0.989) and required no transformations.

Time of annulus formation could not be determined, although gonadal development indicated that the time of capture was very close to the advent of spawning and, therefore, all fish were assumed to have completed at least 1 year of life. An annulus was distinguished from an accessory mark as a zone of closely spaced circuli followed by a zone of widely spaced circuli and by the cutting over of circuli in the lateral fields.

Calculations of length at each annulus were made from measurements of the anterior radius applied in the formula $L_i = c + (S_i/S)(L\text{-}C)$, where L_i is the length of the fish at time of annulus formation, C is the length of the fish at time of back-calculated scale formation (20.16 mm), S_i is the length of the anterior radius of the scale at each annulus, S is the length of the anterior radius at capture, and L is the total length of the fish at capture.

Coefficients of condition (K) were calculated using the formula $K = W/L^3 \times 10^4$, where W = weight in grams and L = total length in millimeters. The length–weight relationships were computed following the method of Jester and Jensen (1972).

Results and Discussion

The mean calculated total lengths of Silver Creek *E. blennioides* in Age Groups I through V were 60.0, 73.2, 84.8, 85.0, and 83.5 mm, respectively (Table 1). Males attained greater lengths than females at all ages. The mean calculated total lengths of males through 4 age groups were 61.6, 74.1, 87.4, and 95.5 mm, and for females through 5 age groups were 58.7, 72.1, 80.8, 81.5, and 83.5 mm. Fahy (1954), in New York, and Lachner et al. (1950), in Pennsylvania, found similar results, but typically *E. blennioides* from Silver Creek were longer than those from either Pennsylvania or New York.

Back calculations of length frequently exhibit a tendency for computed lengths at a given age to be smaller, the older the fish from which they were computed (Tesch 1971). This is commonly known as "Rosa Lee's phenomenon." The data in Table 1 represent a reversal of this which might possibly have been due to a size selective mortality that acted more severely on the smaller fish of an age group.

In Silver Creek, *E. blennioides* males attained 64.5 percent of their calculated maximum mean length during their first year and 77.6 percent by the second year. Females grew faster relative to their own calculated maximum length, attaining 70.3 and 86.3 percent during their first and second years, respectively. Lachner et al. (1950), found that after 2 years, males attained 76.3 percent of their maximum lengths, and females 90.2 percent. Fahy (1954) found male and female growth to be 84 and 82 percent, respectively, after 2 years of life.

The more rapid rate of growth of females was not manifested in the last year of life in either Kentucky or Pennsylvania. The present study indicates that during their last year of life, males grew 7.2 mm (7.5% of maximum growth) and females grew 4.0 mm (4.8%). In Pennsylvania, males grew 8.1 mm (10.5%) and females 0.5 mm (0.8%) during their last year. Fahy (1954) found that in New York males and females had more equal growth, with the males growing 3.8 mm (5.2%) and females 3.7 mm (5.2%) during their last year.

Few fish survived to Age Group IV. Although there were more females than males in Age Group I, more males than females survived to Age Group III. A Chi-Square analysis of the sex ratios revealed that the females significantly outnumbered the males in age group I ($P = 0.01$). In Age Group II, no significant difference was noted, however, by Age Group III there were significantly more males than females ($P = 0.05$). Although females outnumbered

TABLE 1.—MEAN CALCULATED TOTAL LENGTHS OF 203 *E. blennioides*. THE DATA IS SHOWN FOR MALES, FEMALES, AND BOTH SEXES

Age Group	Sex	No. of Fish	Mean calculated total lengths at each annulus				
			1	2	3	4	5
I	Males	40	61.3				
	Females	67	56.9				
	Both	107	58.6				
II	Males	31	58.8	69.8			
	Females	27	61.6	71.2			
	Both	58	60.1	70.4			
III	Males	21	65.6	79.6	87.3		
	Females	9	63.0	75.7	83.1		
	Both	30	64.8	78.4	86.0		
IV	Males	2	68.8	82.6	88.3	95.5	
	Females	4	60.6	72.9	78.7	82.5	
	Both	6	66.3	76.1	81.9	86.8	
V	Males	—	—	—	—	—	—
	Females	2	54.5	66.5	75.0	79.5	83.5
	Both	2	54.5	66.5	75.0	79.5	83.5
Mean Total Lengths	Males	94	61.6	74.1	87.4	95.5	
	Females	109	58.7	72.1	80.8	81.5	83.5
	Both	203	60.0	73.2	84.8	85.0	83.5

males in Age Group IV (4:2), the sample size of 6 fish may not be representative. Only 2 fish were captured from Age Group V, both were females.

Equations for length–weight relationships were calculated after lengths and weights were transformed into logs (base 10). The length–weight equation for males (n = 94) was: Log W = 5.4007 + 3.2278 log L (r = .998) and for the females (n = 109) was: log W = 4.9038 + 2.9713 log L (r = .993). The slope of the length–weight relationship of the males was 3.2278 indicating that the relative weight of the fish increased faster than the length (Ricker 1971). The females have a slope of 2.9713 indicating a slightly faster increase in length when compared to weight. An analysis of covariance (Sokal and Rohlf 1969) indicated that there was no significant difference between the slopes at the 0.05 level; therefore the length–weight relationship for all fish (n = 203) regardless of sex was: log W = 5.1894 + 3.1199 log L (r = .995) (Fig. 1).

Condition factors for *E. blennioides* (Table 2) show an increase with increasing

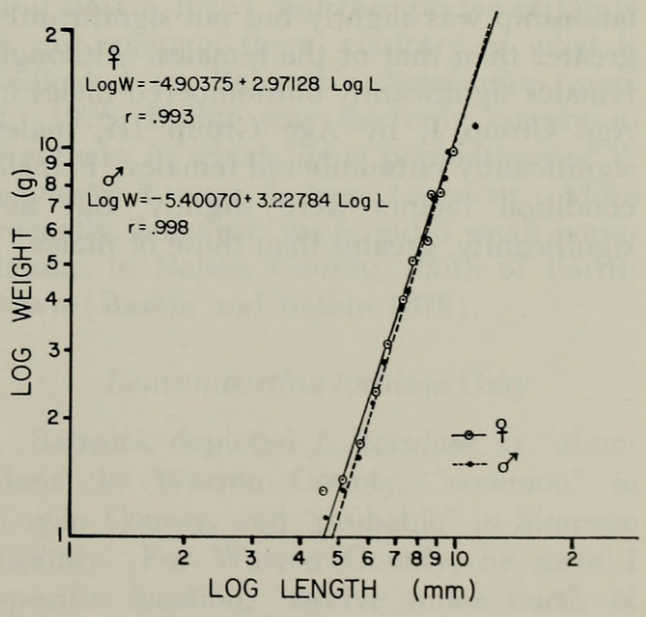

FIG. 1. Length-weight relationship of *Etheostoma blennioides* plotted on log-log paper.

TABLE 2.—COMPARISON OF MALE AND FEMALE *E. blennioides* CONDITION FACTORS FOR EACH AGE GROUP

Age group	Males		Females		Total	
	No.	K	No.	K	No.	K
I	40	1.0071	67	1.0423	107	1.0292
II	31	1.0436	27	1.0846	58	1.0627
III	21	1.1426	9	1.1484	30	1.1443
IV	2	1.1505	4	1.1731	6	1.1655
V	—	—	2	1.1605	2	1.1605

age in both sexes. Although female condition factors were greater at all ages, none of the differences were significant when analyzed by means of a nonparametric *t*-test. The slightly greater values for the females probably was due to their increased weight resulting from ovarian development prior to spawning.

SUMMARY

Age and growth of 203 *Etheostoma blennioides* from Silver Creek, Madison County, Kentucky, indicate that males grew larger than females, but, females grew faster relative to their own maximum lengths. Similar studies on *E. blennioides* in New York and Pennsylvania also demonstrated that males were larger than females. Kentucky specimens were larger than either those of New York or Pennsylvania. The slope of the male length–weight relationship was slightly but not significantly greater than that of the females. Although females significantly outnumbered males in Age Group I, by Age Group III, males significantly outnumbered females. Female condition factors were slightly, but not significantly, greater than those of males.

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