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Age, Growth, and Food Habits of Johnny, Slenderhead and Blacksided Darters of Boone County, Iowa

James R. Karr
Iowa State University

Age, Growth, and Food Habits of Johnny, Slenderhead and Blacksided Darters of Boone County, Iowa[1]

JAMES R. KARR

Abstract. Age, growth, and food habit studies were done on 61 johnny darters, *Etheostoma nigrum,* 25 slenderhead darters, *Percina phoxocephala,* and 18 blacksided darters, *P. maculata,* taken from the Des Moines River, Boone County, Iowa, during the summer 1962. The growth rate of blacksided darter is faster than either of the other two species. Coefficients of condition, length-weight relationships, and body-scale relationships are similar for the three species. The food of all species is over 90% insect. Leeches and tapeworms parasitized the darters.

Six species of darters have been reported from the Des Moines River and its tributaries in Boone County, Iowa (Starrett, 1948). During the present study, only four species were found. These were johnny darter, *Etheostoma nigrum,* blacksided darter, *Percina maculata,* slenderhead darter, *P. phoxocephala,* and striped fantail darter, E. *flabellare.* The two other species reported from the study area previously are western sand darter, *Ammocrypta clara,* and banded darter, *E. zonale.* During May 31 to August 20, 1962, when the collections were made, there was abnormally high rainfall which kept water levels well above normal. This prevented collections for sand darters over sand bars during low water as was recommended by Starrett (1948). By the end of the collection period, 61 johnny, 25 slenderhead, 18 blacksided, and well over 100 striped fantail darters had been collected. Life history data on the striped fantail darters will be reported later.

Collections were made from the Des Moines River throughout the county, from Bluff Creek, a tributary entering the Des Moines River at the SW corner of Sec. 22, R-27W T-84N; and from a small unnamed stream crossing the road between Sec. 29 and 32, R-25W, T-82N.

METHODS AND MATERIALS

During this study several methods of collecting specimens were employed with varying success. The best was a method whereby I would place a long-handled dip net in the water sev-

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eral feet downstream and kick around vigorously in the rocks while moving downstream toward the net. In using this method, it is very important to have the rim of the net touching the bottom throughout its width, or fish will be lost. Seining in the usual way was used with very little success. Employing the seine as described by Daiber (1956) was also tried. His method was to hold the seine across the stream and to have another person kick downstream toward it. It was not found to be as satisfactory as the dip net techniques mentioned before. One reason for this was that two or three people were needed when collections were made with the seine while only one person was needed when employing the dip net.

A 220-volt alternating current electric shocker was also used. Several difficulties were encountered with this method. Since the darters have much reduced swim bladders, they do not come to the surface as do other fish when in the electric field. This could be remedied by moving the hand net along the bottom of the river between the electrodes, but this is a slow process. Another difficulty was controlling the boat over shallow rocky areas where most of the darters were found. The electric shocker was fairly effective for the blacksided darter which was usually found in somewhat deeper water than the other species.

Marked habitat preferences were noted for the different species. Slenderhead and striped fantail darters seemed to prefer similar habitats. Most collections of both species were made in the faster moving rapids in association with larger rocks. Since these species do occupy very similar microhabitats, it was significant that 88% of the slenderheads were taken in the Des Moines River and that 99% of the striped fantails were taken in Bluff Creek. Starrett (1948) found only one striped fantail darter in the Des Moines River and found no slenderhead darters in Bluff Creek. I took specimens of slenderheads as far as 3 or 4 miles above the mouth of Bluff Creek.

Johnny darters were most often found in areas just above and below those where striped fantails were found. Usually they were in somewhat deeper water, almost always characterized by slower water movement.

The larger blacksided darters were found in deeper, slower-moving water in pools. The smaller ones were usually found in shallow water associated with sand.

Measurements

Immediately following capture, fish were killed and preserved in a 10 per cent formalin solution. Within 24 hours, standard (SL), fork (FL), and total lengths (TL) were measured to the nearest millimeter except for the smaller individuals which were interpolated to tenths of a millimeter. Weights were meas-

ured to the nearest hundredth of a gram and were interpolated to the nearest thousandth of a gram for each individual. A triple beam balance was used for weighing the fish.

Factors for the conversion of one length measurement to another were figured and were as follows:

Number specimens	Range (mm TL)		
61	28-70	Johnny Darter	$-$ TL $=$ FL $=$ 1.20SL
25	35-78	Slenderhead Darter	$-$ TL $=$ 1.015FL $=$ 1.17SL
18	29-92	Blacksided Darter	$-$ TL $=$ 1.018 FL $=$ 1.17SL

The total lengths of 9 johnny darters, 26 to 30 millimeters in total length, equalled 1.0098 fork lengths and of 4 darters, 41 to 45 millimeters, equalled 1.0034 fork lengths. No measurable forking of the tail was evident in johnny darters over 45 millimeters.

Age and Growth

Scale Reading. A critique of the scale method for determining age and growth of fish is presented in Van Oosten (1928). Scales were taken from an area slightly below the lateral line and at the rear end of the pectoral fin as it was folded back along the body. The scales were read on a scale projector at a magnification of 80X. There seemed to be a large amount of dried mucous on the scales after they were mounted. I tried soaking them in soapy water to remove this material, but it did not work. Since the scales are so small, it was impossible to remove the mucous with a small brush without damaging them. A sufficient number of scales were taken from each fish to insure that at least one could be read without the mucous interfering.

Several methods were attempted to prepare the scales for reading on a scale projector. The scales were much too small to make impressions on acetate slides. The most satisfactory method was to mount the dry scales between two microscope slides. Areas where circuli showed crowding were designated as annuli. Often it was helpful to take the scale out of focus to determine where dark or crowded areas were. I also found, as did Raney and Lachner (1943), that only the anterior field showed evidence of annulus formation.

Body Scale Relationship. The radius of the scale was measured in millimeters across the anterior field at 80X magnification. The following equations for the relationship of body length to scale radius (Figure 1) were computed by the least squares method.

L $=$ total length (mm) and
R $=$ anterior scale radius (mm) X80.

Johnny Darter	$L = 10.38 + .85944R$
Slenderhead Darter	$L = 18.01 + .98332R$
Blacksided Darter	$L = 17.06 + .92788R$

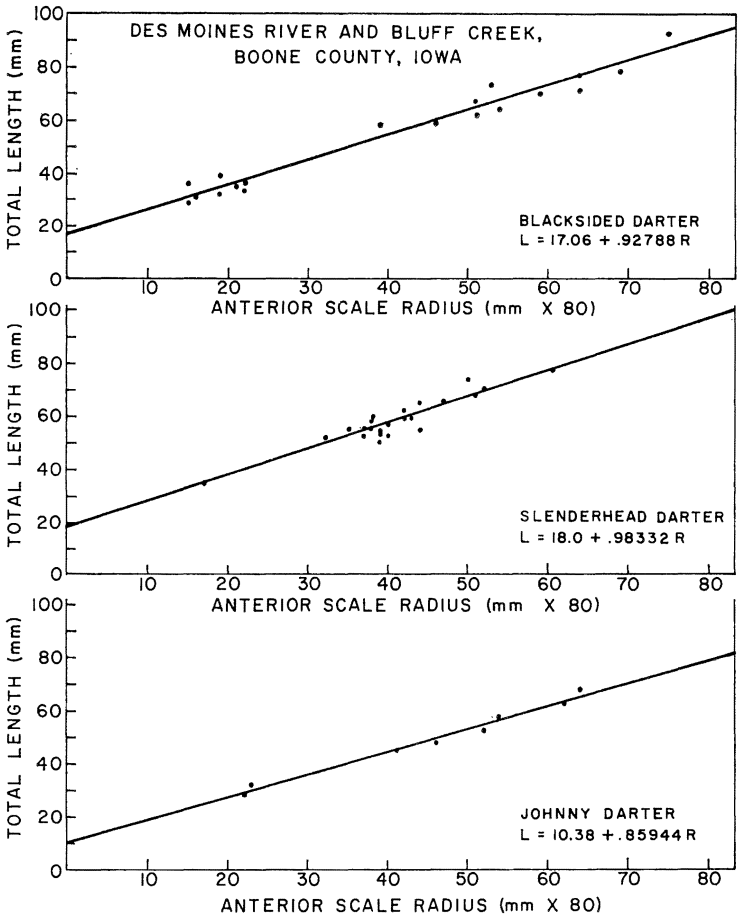

Figure 1. Body-scale relationships of three species of darters.

The johnny darters were grouped into eight 5-millimeter length groups for the computations. Since the number of each of the fish in the other two species was low, each fish was treated individually rather than trying to make any length groupings.

Growth Comparisons. In calculations of lengths at previous annulus formation (Table 1), it was assumed that the growth of the scale and the body length were directly proportional after the scale formation at total length 10, 18, and 17 millimeters for the johnny, slenderhead, and blacksided darters, respectively.

The blacksided darter is the fastest growing of the three species throughout their life span, and the johnny darter is the slowest growing for at least the first 2 years. For the third and fourth years the johnny darter seems to grow faster than the slenderhead darter.

Table 1. Growth data for three species of darters, Des Moines River, Boone County, Iowa, 1962

Johnny Darter

	Number	Length at capture		Mean calculated total length (mm) at annulus			
Age class	fish	Mean	Range	1	2	3	4
I	13	36	28-52	29.5			
II	28	56	45-68	29.3	45.3		
III	13	60	52-70	27.4	39.5	52.9	
IV	1	61	61	22.0	34.0	44.0	56.0
Grand average	55			28.8	43.0	53.2	56.0
Increments of growth				28.8	14.5	13.1	12.0
Number of fish				55	42	14	1

Slenderhead Darter

	Number	Length at capture		Mean calculated total length (mm) at annulus			
Age class	fish	Mean	Range	1	2	3	4
I	1	35	35	32.0			
II	17	58	50-74	35.6	49.0		
III	5	57	53-62	32.0	42.4	51.2	
IV	2	72	66-78	27.5	36.5	45.0	56.0
Grand average	25			34.1	46.6	49.4	56.0
Increments of growth				34.1	19.2	8.6	11.0
Number of fish				25	24	7	2

Blacksided Darter

	Number	Length at capture		Mean calculated total length (mm) at annulus			
Age class	fish	Mean	Range	1	2	3	4
I	7	39	31-62	32.9			
II	6	65	58-71	35.7	51.7		
III	2	76	73-78	37.5	51.0	69.0	
IV	1	92	92	36.0	47.0	58.0	77.0
Grand average	16			34.7	50.9	65.3	77.0
Increments of growth				34.7	14.9	17.7	19.0
Number of fish				16	9	3	1

The johnny and slenderhead darter data show Lees' phenomenon (Ricker, 1958). That is, the younger fish appear to grow faster than the older fish did early in their lives. The most likely explanation is that the slower-growing fish live longer than the faster-growing fish.

Johnny darters of the Des Moines River are 4 to 5 millimeters smaller in the first 2 years than those reported from New York (Raney and Lachner, 1943) but about the same as those from Michigan (Speare, 1960). In the third year the Iowa and New York darters are about of the same size but 5 millimeters longer than those from Michigan. No fourth year data are given in the other papers.

Condition and Length-Weight Relationship

The coefficient of condition, K, is a method used to determine

the relative robustness or well being of a fish (Lagler, 1956).

From the formula

$$K(TL) = \frac{W\ 10^5}{L^3}$$

where W = weight in grams
and L = total length in millimeters

The average K(TL) factors were:

Number of fish	Range of total length		K
61	28-70	Johnny darter	1.382
25	35-78	Slenderhead darter	1.392
18	29-92	Blacksided darter	1.362

The length-weight relationship (Figure 2) was computed for each of the three species of darters from the formula

$$\text{Log } W = \text{Log } c + n \log L$$

where c and n are constants
W = weight in grams
L = total length in millimeters

Johnny darter	Log W = − 4.305 + 3.12 Log L
Slenderhead darter	Log W = − 4.405 + 3.19 Log L
Blacksided darter	Log W = − 4.166 + 3.05 Log L

In all cases weight increases more rapidly than the cube of the length, which indicates that the darters become somewhat plumper as they increase in average length.

Food Habits

Insects were the principle foods of the three darters (Table 2). Insect orders represented were Diptera, Ephemeroptra, Tricoptera, and Odonata in order of importance.

Crustaceans were of minor importance in the johnny darter, were entirely absent in the slenderhead darter, and occurred once in blacksided darter. Crustaceans present included Ostracoda, Cladocera, and Copepoda.

Small stones and plant material were recorded in the stomachs of each species. These were probably picked up only incidentally in normal feeding.

Parasites

One slenderhead darter had a leech of the family Piscicolidae attached to the caudal fin. A blacksided darter had a leech of the same family on the base of the doral fin. Both of these fish were taken in the same area on the same day.

Two johnny darters contained tapeworms of the family Bothriocephalidae. These two specimens were taken about 13 miles apart. One was taken in Bluff Creek and the other in the Des Moines River.

Table. 2. Food contents of stomachs of darters, Boone County, Iowa, 1962

	Johnny darter		Slenderhead darter		Blacksided darter	
	Per cent of occurrence	Per cent of items	Per cent of occurrence	Per cent of items	Per cent of occurrence	Per cent of items
Inorganic (small stones)	27	..	7	..	44	..
Organic	100	..	100	..	100	..
Plant	12	..	7	..	11	..
Animal	100	100.0	100	100.0	100	100.0
Undetermined	35	2.4	36	5.0	55	8.9
Determined	100	97.6	86	95.0	89	91.1
Insect	96	91.0	93	95.0	100	90.4
Diptera	96	88.0	50	19.9	66	38.2
Chironomidae	92	68.5	29	9.2	66	36.3
Simuliidae	4	0.2	29	10.7	..	..
Dolichopodidae	19	1.4	..	..	11	1.9
Ceratopogonidae	31	16.2	..	..	..	..
Ephydridae	15	1.6	..	..	..	..
Psychodidae	4	0.1	..	..	..	..
Ephemeroptera	39	1.0	86	61.0	77	51.6
Heptageniidae	15	0.4	71	25.5	33	10.8
Baetidae	23	0.4	64	27.7	44	40.8
Caenidae	8	0.1	29	5.0	..	..
Ephemeridae	4	0.2	14	2.8	..	..
Odonata	4	0.1	..	..	..	..
Tricoptera	46	1.9	50	14.1	11	.6
Hydropsychidae	46	1.9	50	14.1	11	.6
Crustaceans	35	3.7	..	..	11	.7
Ostracoda	35	3.1	..	..	11	.7
Cladocera	15	0.3	..	..	..	..
Copepoda	8	0.3	..	..	..	..
Other	27	2.9	..	..	..	..
Fish eggs	4	1.4	..	..	..	..
Hydrachnida	4	0.1	..	..	..	..
Nematoda	19	0.9	..	..	..	..
Oligocherta	15	0.5	..	..	..	..
Number of stomachs	26	26	14	14	9	9
Number of animal items		1711		141		157

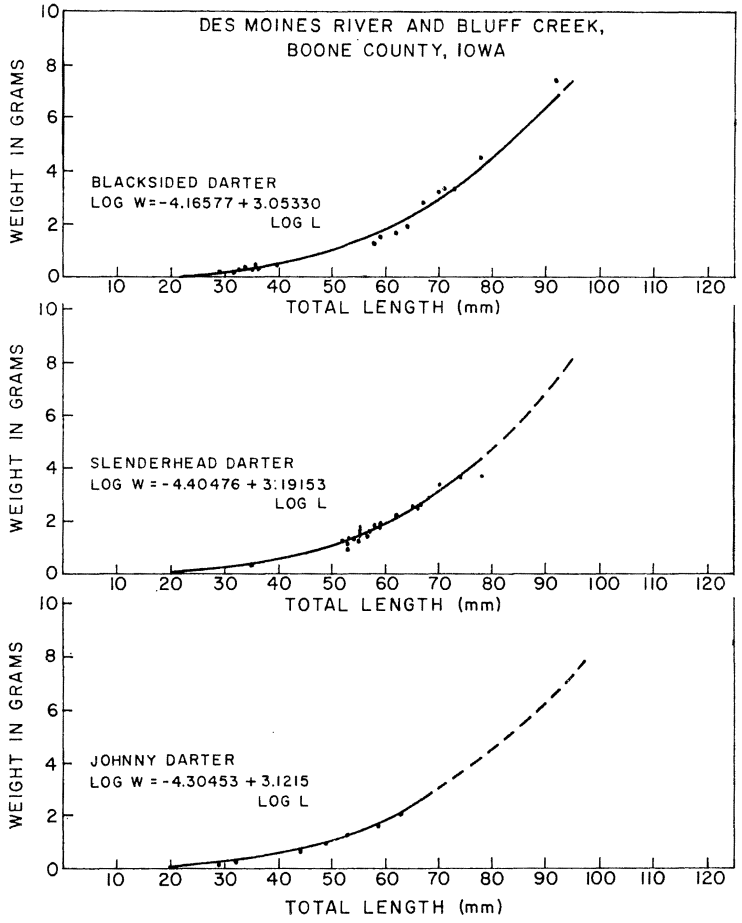

Figure 2. Length-weight relationships of three species af darters.

Egg Count

Egg counts were made in specimens where this was possible. Numbers of eggs in five johnny darters ranged from 198 to 650, a mean of 388, and of six slenderheaded darters ranged from 186 to 365 eggs with a mean of 288.

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Minnow Population of Grimes Creek in Relation to Pollution

Earl E. Kelling[1]

Abstract. Weekly minnow collections were made from August 13 to November 26, 1960, at five stations in Grimes Creek. Six major species were identified, counted and measured. The upper region of the creek was abandoned by the minnow population within a few days after pollution from a canning factory at Grimes, Iowa entered the stream. Late spawning species of minnows were unable to spawn successfully, which suggested one mechanism for selective evolution of minnow populations.

As the human population of the state grows the demand for the natural resources of the state increases. With the increased demand for the use of resources the natural environments of many living creatures are destroyed or changed so that they are not suitable for maintenance of life. In some cases this change is not rapid, but over a period of years it is found that many species have diminished in number or have disappeared from their former habitats.

Minnow populations of Iowa streams have changed due to the many environmental conditions they encounter from year to year, (Harlan and Speaker, 1956.) Some of the factors affecting

[1] Graduate Student, Biology Department, Drake University.