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SYSTEMATIC STUDIES OF DARTERS OF THE SUBGENUS *CATONOTUS* (PERCIDAE), WITH THE DESCRIPTION OF A NEW SPECIES FROM THE LOWER CUMBERLAND AND TENNESSEE RIVER SYSTEMS

By

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In 1892 *Etheostoma obeyense* was described by P. H. Kirsch from tributaries of the Cumberland River in Clinton County, Kentucky, and since that time has been considered to be one of only two species of barcheek darters in the Cumberland drainage, the other being *E. virgatum*. However, individuals considered until now to be *E. obeyense* actually represent two distinct but morphologically similar species. *Etheostoma obeyense* is distributed in tributaries of the middle Cumberland River, and a second species, described herein, is in tributaries of the lower Cumberland and lower Tennessee rivers.

METHODS

Characters.—The characters examined were numbers of lateral scales, pored lateral line scales, scales above and below the lateral line, scales around the caudal peduncle, transverse scales, infraorbital canal pores, supratemporal canal pores, preoperculomandibular pores, dorsal fin spines, dorsal fin rays, branched caudal fin rays, pectoral fin rays, anal fin spines, and anal fin rays; pigmentation patterns; squamation patterns (*i.e.*, amount of squamation on various areas of the body); head length/standard length (HL/SL); head width/SL (HW/SL); body depth/SL (BD/SL); caudal peduncle depth/SL (CPD/SL); pectoral fin length/SL (PIL/SL);

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predorsal length/SL (PreDL/SL); second dorsal fin base length/first dorsal fin base length (D2L/D1L); preorbital length/BD (PreOL/BD); interorbital width/head width (IOW/HW); BD/anal fin length (BD/AL); first dorsal fin height/D1L (D1H/D1L); pelvic fin length/SL (P2L/SL); eye diameter/HL (ED/HL); eye diameter/SL (ED/SL); gape width/preorbital length (GW/PreOL); cheek bar width/PreOL (CBW/PreOL); and second dorsal fin length/distance from the anterior origin of the second dorsal fin to the caudal base (D2FL/QL).

Counts and measurements were made as described by Hubbs and Lagler (1964) with the following exceptions. The number of transverse scales was counted in two ways—from the anal fin origin to the first dorsal fin base, and from the anal fin origin to the second dorsal fin base. Body depth was measured at the origin of the first dorsal fin. First dorsal fin height is the length of the second spine. Preorbital length is the distance from the tip of the snout to the anterior margin of the orbit. Pectoral fin and pelvic fin lengths are the lengths of the longest rays. Second dorsal fin length was measured from the origin of the fin to the tip of the most posterior-reaching ray. Cheek bar width is its greatest transverse distance. Eye diameter is the greatest transverse distance across the orbit. Head canal pore counts were made on the left side only and in the manner described by Hubbs and Cannon (1935).

Analysis.—Counts and measurements (measurements are expressed as proportions of one another) were compared among samples determined by sex (dimorphic), by size class (ontogenetic), by river system (geographic), and by longitude (geographic). For some comparisons (*e.g.* Table 3) adjustments were made by limiting samples to reduce the influence of other potential sources of variation (in Table 3, ontogenetic). One-way analysis of variance tests were run to determine significances of differences in means of samples determined by sex, size class, and geography.

Etheostoma smithi, new species
Slabrock Darter

Holotype.—Illinois Natural History Survey 75013, an adult male 51.7 mm SL (Fig. 1), collected in Ferguson Creek at the Route 70 bridge (37°6′ N, 87°24′ W) 3 km E Smithland, Livingston County, Kentucky, on 26 April 1975 by L. M. Page, B. M. Burr, and J. A. Boyd.

Paratopotypes.—A total of 121 specimens deposited as follows: 13—Illinois Natural History Survey (INHS 75014, 25-51 mm SL, 26 Apr. 1971); 24—University of Michigan Museum of Zoology (UMMZ 197498, 22-51 mm SL, 22 Apr. 1971); 24—U. S. National Museum (USNM 214525, 26-49 mm SL, 20 May 1973); 14—The University of Kansas (KU 16227, 15-41 mm SL, 29 May 1972);

FIG. 1.—*Etheostoma smithi* holotype, male, 51.7 mm SL, Ferguson Creek, Livingston Co., Kentucky, 26 April 1975.

13—Northeast Louisiana University (NLU 32515, 23-50 mm SL, 20 Feb. 1973); 13—Tulane University (TU 95964, 30-43 mm SL, 27 May 1971); 12—University of Alabama (UAIC 5021.01, 23-47 mm SL, 18 Jan. 1972); 8—University of Tennessee (UT 91.1099, 30-50 mm SL, 3 May 1971).

Material examined.—Drainages are listed in a west-to-east direction. Numbers in parentheses are numbers of specimens examined. Complete collection locality data are available from the first author. CUMBERLAND R. DR.: Ferguson Cr.: INHS 75013 (1), 75014 (5), 75016 (11), 75017 (10), UMMZ 197498 (11); Sandy Cr.: INHS 75018 (2); Clay Lick Cr.: UMMZ 174983 (3); Goose Cr.: UMMZ 174858 (2); South Cross Cr.: CU (Cornell University) 47400 (1); Elk Cr.: CU 47859 (17); Wells Cr.: INHS 75019 (1); Richland Cr.: UMMZ 174482 (6), 177571 (5); Whites Cr.: USNM 188733 (5); Stones R.: INHS 75029 (21), TU 19470 (1), NLU 15779 (1); Drake Cr.: UMMZ 88070 (2); Bledsoe Cr.: UMMZ 174440 (1), UAIC 2974 (1); Spring Cr.: MEB (M. E. Braasch) 80 (7). TENNESSEE R. DR.: Whiteoak Cr.: INHS 75038 (3), TU 89495 (1), UT 91.552 (2); Hurricane Cr.: INHS 75039 (4), UT 91. (2).

Etymology.—The new species is named for Dr. Philip W. Smith, Head of the Section of Faunistic Surveys and Insect Identification of the Illinois Natural History Survey, in recognition of his outstanding contributions to vertebrate natural history. The common name, slabrock darter, refers to the preference of the species for slabrock habitats.

Diagnosis.—The subgenus *Catonotus* of *Etheostoma* was diagnosed by Kuehne and Small (1971). *Etheostoma smithi* is distinguished from all other members of the subgenus by the following combination of characteristics: a bicolored bar on cheek; red and blue pigments on fins and head; caudal fin without distinct black vertical bands; infraorbital canal interrupted, with three pores anteriorly and one posteriorly (Fig. 2); 10 preoperculomandibular

pores; no conspicuous dark longitudinal stripes on sides; no (or a weak) suborbital bar; adults (over 35 mm SL) with 13 or fewer pored lateral line scales; usually with 14 dorsal fin rays.

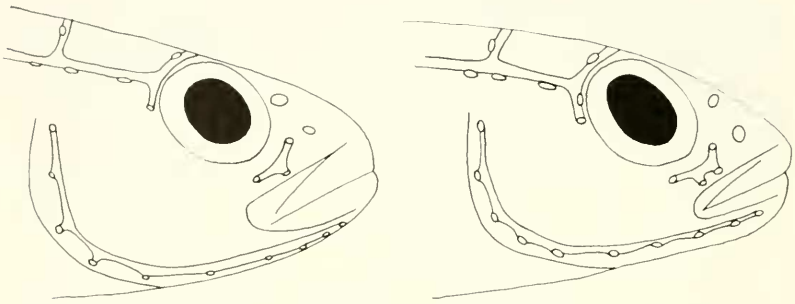

FIG. 2.—Head canals of *Etheostoma smithi* (left) and *E. obeyense* (right). The infraorbital canal of *E. smithi* has three pores anteriorly and one posteriorly; of *E. obeyense* has four pores anteriorly and two posteriorly.

Comparisons.—Etheostoma smithi can be distinguished from the other described barcheek darters as follows. *Etheostoma obeyense*, the closest relative, has four pores in the anterior segment of the infraorbital canal, usually two pores in the posterior segment of the infraorbital canal, 12 or more pored lateral line scales (in adults), 13 dorsal fin rays, and a mean PreOL/BD of 0.44 (0.39 in *E. smithi*) (Tables 1-3). *Etheostoma barbouri* has a strong teardrop, usually nine preoperculomandibular pores, and 13 dorsal fin rays. *Etheostoma virgatum* has conspicuous dark longitudinal stripes on the sides, usually four pores in the anterior segment of the infraorbital canal, and two pores in the posterior segment of the infraorbital canal.

Description.—A small *Catonotus* reaching 52 mm SL; elongated with a terminal mouth, and compared to its closest relative, *E. obeyense*, with a significantly ($\alpha = 0.005$) shorter snout (preorbital length). Infraorbital canal interrupted (Fig. 2) with three pores anteriorly (99% of the specimens examined; N = 115) and one pore posteriorly (99%; N = 115); supratemporal canal interrupted medially with pores usually 2—2; usually 10, rarely nine, preoperculomandibular pores; snout with a rather broad frenum; six branchiostegal rays on a side, with the branchiostegal membranes separate or slightly fused; preopercle crenulate.

Head unscaled; body scaled except for the nape, breast, and prepectoral area; nape unscaled to approximately the origin of the first dorsal fin; 41 to 54 lateral scales; 2 to 13 (usually 10 or fewer) pored lateral line scales; 14 to 17 transverse scales from anal fin origin to first dorsal fin; 12 to 15 scales to second dorsal fin; 17 to 22 (usually 19 or 20) scales around caudal peduncle.

TABLE 1.—Counts of pored lateral line scales in *Etheostoma smithi* and *E. obeyense* over 35 mm SL.

Species & Drainage	No. Pored Scales																									N	X̄	SD	CV
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26				
Etheostoma smithi																													
Cumberland R. Drainage																													
Ferguson Cr., KY				2	3	4	4	6	4	3	2	1														29	8.7	2.12	24.4
tribs., Livingston, Crittenden, Caldwell cos., KY				2	2																					4	5.5	0.58	10.5
Elk Cr., TN		1		1	2	2	2	2	1																	11	7.1	2.02	28.4
Richland Cr., TN	1	1	2	1	1	1																				7	4.4	1.72	38.8
Whites Cr., TN					1		1	2				1														5	9.0	2.54	28.3
Stones R., TN					1	1	1		1																	4	7.8	1.71	21.9
Tennessee R. Drainage				2	1	3		1																		7	6.6	1.40	21.2
TOTALS:	1	2	2	8	11	11	8	11	6	3	2	2																	
Etheostoma obeyense																													
Obey R., TN										1	2		1	1	2		1									8	14.3	2.43	17.0
Wolf R. (Obey R. trib.), KY & TN									1			1	4	7	2	3	4	3	3			1				29	16.5	2.69	16.3
Marrowbone Cr., KY													1	2	1	1					1					6	16.5	2.88	17.5
Crocus Cr., KY												1						1	1					1		4	19.3	4.92	25.5
Beaver Cr., KY										1		1	1			1										4	13.8	2.50	18.1
Fishing Cr., KY													1		1		3	2	2		1	2		3	2	17	21.0	3.69	17.6
Pitman Cr., KY												2			2	3	3									10	16.3	1.89	11.6
Little S. Fk., KY											3	2	1	1	5	2	3	1		1						19	15.7	2.56	16.2
Rock Cr., TN															2		1	2	2	2	1	2	1	2		15	20.8	2.91	14.0
TOTALS:									1	2	5	7	9	11	15	10	15	9	8	3	3	5	1	6	2				

TABLE 2.—Counts of infraorbital canal pores in *Ethcostoma smithi* and *E. obeyense*.

Species & Drainage	Anterior Segment of Canal						Posterior Segment of Canal					
	No. Pores						No. Pores					
	3	4	*N*	$\bar{X}$	SD	CV	1	2	*N*	$\bar{X}$	SD	CV
Ethcostoma smithi												
Cumberland R. Drainage												
Ferguson Cr., KY	38		38	3.0	0.00	0.0	38		38	1.0	0.00	0.0
tribs., Livingston, Crittenden, Caldwell cos., KY	7		7	3.0	0.00	0.0	6	1	7	1.1	0.38	0.0
Elk Cr., TN	17		17	3.0	0.00	0.0	17		17	1.0	0.00	0.0
Richland Cr., TN	10		10	3.0	0.00	0.0	10		10	1.0	0.00	0.0
Whites Cr., TN	5		5	3.0	0.00	0.0	5		5	1.0	0.00	0.0
Stones R., TN	19	1	20	3.1	0.22	7.3	20		20	1.0	0.00	0.0
Spring Cr., TN	7		7	3.0	0.00	0.0	7		7	1.0	0.00	0.0
Tennessee R. Drainage	12		12	3.0	0.00	0.0	12		12	1.0	0.00	0.0
TOTALS:	115	1					115	1				
Ethcostoma obeyense												
Obey R., TN		7	7	4.0	0.00	0.0	1	6	7	1.9	0.38	20.0
Wolf R. (Obey R. trib.), KY & TN	1	22	23	3.9	0.21	5.4	3	20	23	1.9	0.34	18.1
Marrowbone Cr., KY		7	7	4.0	0.00	0.0	5	2	7	1.3	0.49	37.5
Crocus Cr., KY		10	10	4.0	0.00	0.0	2	8	10	1.8	0.42	23.4
Beaver Cr., KY	2	14	16	3.9	0.34	8.7	9	7	16	1.4	0.51	36.6
Fishing Cr., KY		19	19	4.0	0.00	0.0	6	13	19	1.7	0.48	28.1
Pitman Cr., KY		10	10	4.0	0.00	0.0	1	9	10	1.9	0.32	16.6
Little S. Fk., KY	1	19	20	3.9	0.22	5.6	6	14	20	1.7	0.47	27.6
TOTALS:	4	108					33	79				

TABLE 3.—Counts of dorsal fin rays in *Etheostoma smithi* and *E. obeyense*.

Species & Drainage	No. Fin Rays 12	13	14	15	N	$\bar{X}$	SD	CV
Etheostoma smithi								
Cumberland R. Drainage								
Ferguson Cr., KY		10	23	5	38	13.9	0.62	4.5
tribs., Livingston, Crittenden, Caldwell cos., KY			7		7	14.0	0.00	0.0
Elk Cr., TN		2	10	5	17	14.2	0.64	4.5
Richland Cr., TN		3	6	2	11	13.9	0.70	5.0
Whites Cr., TN			3	2	5	14.4	0.55	3.8
Stones R., TN	1	7	13	2	23	13.7	0.70	5.1
Spring Cr., TN			4	3	7	14.4	0.53	3.7
Tennessee R. Drainage		2	7	3	12	14.1	0.67	4.7
TOTALS:	1	24	73	22				
Etheostoma obeyense								
Obey R., TN	1	5	5		11	13.3	0.67	5.0
Wolf R. (Obey R. trib.), KY & TN	12	33	6		51	12.9	0.59	4.6
Marrowbone Cr., KY	3	4			7	12.6	0.53	4.3
Crocus Cr., KY	6	3	1		10	12.5	0.71	5.7
Beaver Cr., KY	2	13	1		16	12.9	0.44	3.4
Fishing Cr., KY	3	10	6		19	13.2	0.69	5.2
Pitman Cr., KY		6	4		10	13.4	0.52	3.9
Little S. Fk., KY		8	14	2	24	13.8	0.61	4.4
Rock Cr., TN		12	3	1	16	13.3	0.60	4.5
TOTALS:	27	94	40	3				

Eight to 10 (usually 9) dorsal fin spines, without knobs; second dorsal fin elongated with 13 to 15 (usually 14) rays; 11 to 16 (usually 14) branched caudal fin rays; 11 to 13 (usually 12) pectoral fin rays; usually 2 anal fin spines; 8 to 10 (usually 9) anal fin rays; 1 pelvic fin spine; 5 pelvic fin rays.

Body proportions: HL/SL, 0.26-0.36 ($\bar{X} = 0.30$); HW/SL, 0.11-0.16 (0.14); BD/SL, 0.15-0.21 (0.18); CPD/SL, 0.08-0.13 (0.10); P1L/SL, 0.22-0.27 (0.25); PreDL/SL, 0.33-0.36 (0.34); PreOL/BD, 0.30-0.46 (0.39); D2L/D1L, 0.80-1.42 (1.19); IOW/HW, 0.29-0.52 (0.36); GW/PreOL, 0.82-1.32 (1.07); BD/AL—males, 0.49-0.61 (0.56); BD/AL—females, 0.57-0.72 (0.64); D2FL/QL—males, 0.83-0.94 (0.90); D2FL/QL—females, 0.78-0.85 (0.82); ED/HL, 0.20-0.33 (0.26); D1H/D1L, 0.33-0.51 (0.43); P2L/SL, 0.18-0.23 (0.20); ED/SL, 0.06-0.11 (0.08); CBW/PreOL, 0.48-0.68 (0.57).

Coloration in life: Juveniles, females, and non-breeding males with nearly identical pigmentation; large males sometimes darker, retaining some breeding colors for variable lengths of time after the breeding season; large, summer-collected males often have more red in the fins than do females. In non-breeding individuals (Fig.

3), body straw-colored dorsally with 6 to 8 dark brown rectangular saddles on the mid-dorsum—the first (sometimes absent) being anterior to the origin of first dorsal fin and the last at the origin of the caudal fin; dorsal saddles especially prominent on specimens from Stones River. Series of 9 to 12 vertically elongated dark

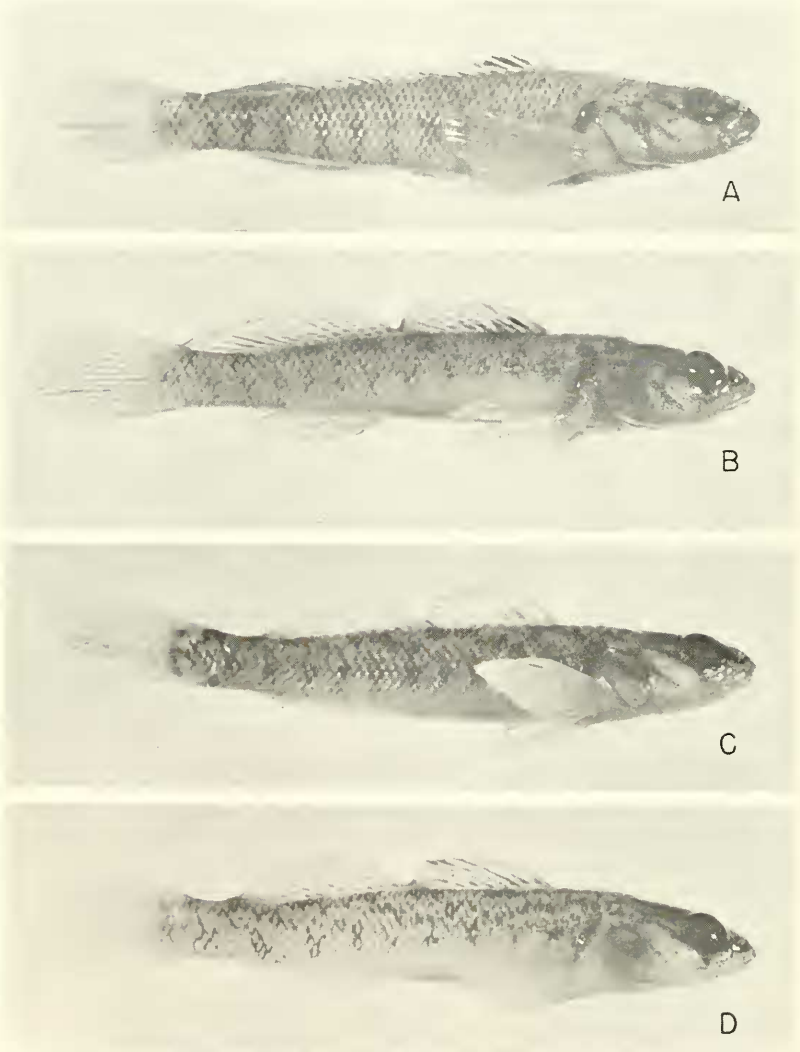

FIG. 3.—A. *Etheostoma smithi* male, 44 mm SL, Ferguson Cr., Livingston Co., Kentucky, 10 Dec. 1971; B. *E. obeyense* male, 54 mm, Smith Cr., Clinton Co., Kentucky, 26 July 1975; C. *E. smithi* female, 36 mm, Ferguson Cr., Livingston Co., Kentucky, 24 Nov. 1972; D. *E. obeyense* female, 37 mm, Smith Cr., Clinton Co., Kentucky, 2 July 1975.

brown blotches mid-lateraly extending only about two-thirds of distance to midventer anteriorly, but encircling or nearly encircling venter on caudal peduncle. Variously developed vermiculations of same or slightly lighter color between lateral blotches and dorsal saddles. Breast and belly white to straw color; breast usually spotted with large melanophores. Humeral spot large and black.

Dorsum of head dark brown to black posteriorly and lighter anteriorly with patches of melanophores; distinct preorbital bars converging but not meeting on the upper lip; occasional faint suborbital bar; cheeks heavily spotted with large melanophores. Cheek bar with black outline; lower half of cheek bar white to silver; upper half red to orange; iridescence of lower half producing a mirror effect. Opercle, underside of head, and branchiostegal membranes heavily spotted with large melanophores.

First dorsal fin with large, anterior, basal, black blotch best developed between second and fifth spines; rest of fin clear except for scatterings of melanophores and a marginal or submarginal red band; sometimes thin black band distally outlining red band. Second dorsal and caudal fins with bands formed by concentrations of red-brown and black pigments on fin membranes. Pectoral fin similarly banded, with melanophores along rays, or clear. Pelvic fin clear. Anal fin clear except for red-brown and black pigment spots basally on membranes.

Breeding male (Fig. 1) spectacularly colored with bold, predominantly red dorsal, caudal, and anal fins; blotch in first dorsal fin blacker and larger than in nonbreeding males and surrounded by red; anal fin and lower half of caudal fin develop a blue-black margin; breast and pelvic fins black; pectoral fins reddish medially with wide, black margin, best developed ventrally; head dark and swollen; cheek bar vivid; humeral spot especially prominent; vertical bars on sides dark and more elongate than in nonbreeding males; tubercles absent.

Variation.—Means of three of the 29 characteristics of *Etheostoma smithi* tested show highly significant ($\alpha = 0.005$) sexual dimorphism. Males have more dorsal fin rays, a smaller BD/AL ratio, and a larger D2FL/QL ratio (Table 4). Among these three characters, only the D2FL/QL ratio is also sexually dimorphic in both of the other species of *Catonotus* that have been examined—*E. kennicotti* (Page and Smith 1976) and *E. obeyense* (Table 4). A second dorsal fin longer in males than in females is characteristic of all three species.

Means of six of the 29 characteristics tested show highly significant variation among three size classes, as follows: <35 mm SL; 35.1-40.0 mm SL; and >40.0 mm SL. Only the values for the smallest and largest classes are shown in Table 5. Larger *E. smithi* have more pored lateral line scales. Relative to standard length, larger individuals have a shorter head, body depth, pelvic fin

TABLE 4.—Characters showing sexual dimorphism in *Etheostoma smithi* and *E. obeyense*.

Character	Males					Females				
	N	$\bar{X}$	95%CI	SD	CV	*N*	$\bar{X}$	95%CI	SD	CV
Etheostoma smithi										
No. dorsal fin rays	45	14.3	14.1-14.5	0.59	4.2	46	13.8	13.6-14.0	0.54	3.9
BD/AL	9	0.560	0.530-0.590	0.0466	8.3	9	0.638	0.609-0.667	0.0438	6.9
D2FL/QL	10	0.896	0.877-0.915	0.0307	3.4	9	0.815	0.798-0.832	0.0257	3.2
Etheostoma obeyense										
PreDL/SL	14	0.353	0.349-0.357	0.0082	2.3	12	0.366	0.360-0.372	0.0109	3.0
BD/AL	14	0.558	0.536-0.580	0.0421	7.5	12	0.694	0.657-0.731	0.0658	9.5
D2FL/QL	14	0.917	0.894-0.940	0.0431	4.7	12	0.793	0.770-0.816	0.0401	5.1

TABLE 5.—Ontogenetically variable characters of *Etheostoma smithi* and *E. obeyense*.

Character	Size Classes									
	< 35.0 mm SL					> 40.0 mm SL				
	N	$\bar{X}$	95%CI	SD	CV	*N*	$\bar{X}$	95%CI	SD	CV
Etheostoma smithi										
No. pored lateral line scales	33	5.8	4.8-6.8	2.83	49.1	27	7.7	6.8-8.6	2.41	31.3
HL/SL	13	0.318	0.308-0.328	0.0176	5.6	19	0.298	0.288-0.308	0.0215	7.2
BD/SL	8	0.197	0.191-0.203	0.0088	4.5	9	0.173	0.167-0.179	0.0095	5.5
P2L/SL	8	0.217	0.207-0.227	0.0140	6.5	7	0.195	0.188-0.202	0.0098	5.0
ED/HL	8	0.292	0.277-0.308	0.0224	7.7	4	0.222	0.206-0.238	0.0166	7.5
ED/SL	8	0.095	0.089-0.101	0.0083	8.8	4	0.064	0.059-0.069	0.0052	8.2
Etheostoma obeyense										
No. pored lateral line scales	44	13.5	12.3-14.8	4.22	31.2	76	18.0	17.1-18.9	3.83	21.3
HL/SL	31	0.328	0.323-0.333	0.0149	4.6	44	0.306	0.298-0.314	0.0256	8.4
BD/SL	27	0.188	0.183-0.193	0.0131	7.0	42	0.178	0.174-0.182	0.0142	8.0
ED/HL	27	0.313	0.300-0.326	0.0341	10.9	42	0.261	0.245-0.277	0.0523	20.1
ED/SL	27	0.102	0.098-0.106	0.0117	11.4	43	0.079	0.075-0.083	0.0138	17.4
D1H/D1L	26	0.512	0.486-0.538	0.0670	13.1	22	0.378	0.362-0.394	0.0393	10.4

length, and eye diameter; and relative to head length, a shorter eye diameter.

Geographic variation among characteristics examined in *Etheostoma smithi* is minor and no clinal or other consistent pattern of variation is evident. Although a hiatus within the Cumberland River distribution of *E. smithi* is as large as the hiatus between the ranges of *E. smithi* and *E. obeyense*, no morphological difference between the eastern and western populations of *E. smithi* was found.

Ten of the 12 specimens examined from the Tennessee River system have eight dorsal fin spines; a majority (56%) of the specimens from the Cumberland River system have nine dorsal fin spines. No other differences were found between the samples from these two major river systems.

The sample from Stones River, Rutherford Co., Tennessee, is the most unusual of the *Etheostoma smithi* examined. There is more contrast between light and dark pigments on these individuals than on individuals from other drainages, and the dorsal saddles are especially prominent. The dorsal saddle anterior to the first dorsal fin, which is usually weak or absent in *E. smithi*, is strongly developed in the Stones River population. In addition, the Stones River specimens have fewer than the usual number of dorsal fin rays (Table 3) and a reduced number of pectoral rays ($\bar{X} = 11.5$; all other samples except that from Elk Creek, Stewart Co., Tennessee, have means of 12.0 or more).

The population in Richland Creek, Davidson Co., Tennessee, is somewhat unusual, having especially low numbers of pored lateral line scales (Table 1), of branched caudal fin rays ($\bar{X} = 12.9$; all other samples have means over 14.1), and of lateral scales ($\bar{X} = 45.1$; other samples except that from Spring Creek, Wilson Co., Tennessee, have means over 45.5).

Distribution and Habitat.—Etheostoma smithi occurs in tributaries of the lower Cumberland River from near the mouth of the Cumberland River in western Kentucky to near the Caney Fork system in north central Tennessee and in tributaries of the lower Tennessee River (Fig. 4). Based on presently available locality data on museum specimens, there is a large hiatus in the Cumberland River distribution of the species in Tennessee; the hiatus extends from approximately the abrupt bend in the Cumberland River at Cumberland City to near Nashville. A collecting trip by the authors in November, 1975, to this area failed to produce any specimens of *E. smithi*. At present *E. smithi* is known in the Tennessee River system from only two tributaries: Whiteoak Creek, a direct tributary of the lower Tennessee River in Humphreys and Houston counties, Tennessee; and Hurricane Creek, a tributary of the lower Duck River in Humphreys County, Tennessee.

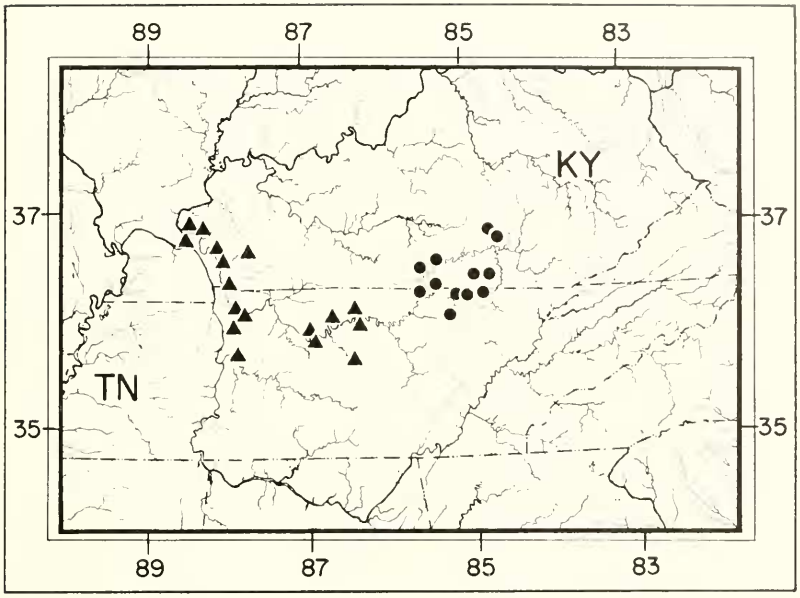

FIG. 4.—Distribution of localities from which *Etheostoma smithi* (triangles) and *E. obeyense* (circles) have been collected.

With the exception of the approximately 900 specimens of *E. smithi* collected from the type-locality, most collections of the species are quite small. The species is usually present in small populations, and difficulty in collecting is further exacerbated by the difficulty of collecting in slabrock pools.

The habitat of *E. smithi* is shallow, slabrock pools in streams. A life history study similar to those recently published on other *Catonotus* (Page 1974, 1975a) is completed for *E. smithi* in Ferguson Creek, Livingston Co., Kentucky, and is awaiting publication.

Etheostoma obeyense Kirsch 1892

Barcheek Darter

Etheostoma obeyense Kirsch, 1892:292 (original description).

Poecilichthys obeyensis.—Shoup, Peyton, and Gentry, 1941:70 (list of fishes of the Obey River).

Types.—Etheostoma obeyense was described in 1892 on the basis of 210 specimens from four Cumberland River tributaries in Clinton County, Kentucky. Of the 210, 21 were from Indian Creek, 36 from Spring Creek, 23 from Smith Creek, and 130 from Albany Branch. The original description included a figure of the new species, later reproduced by Jordan and Evermann (1896) who also redescribed the species and selected a lectotype (USNM

45565). Collette and Knapp (1966) erred in stating that the figure of *E. obeyense* in Jordan and Evermann (1896) was of the lectotype.

Collette and Knapp (1966) located the following types of *E. obeyense:* lectotype, USNM 45565 (male, trib., Cumberland R., 52 mm SL); paralectotypes, SU (Stanford University) 5116 (41 specimens, Albany Br., 28-51 mm SL), SU 1918 (38, Spring Cr., 32-55 mm SL), and BMNH (British Museum) 1892.12.30.136-139 (4, Albany Br., 35-41 mm SL). In addition UMMZ has a series of 43 paralectotypes (UMMZ 61558, 30-44 mm SL) from Albany Br., collected in 1891 by P. H. Kirsch. The collection was formerly IU (Indiana University) 4318.

Material examined.—Drainages are listed in a west-to-east direction. Numbers in parentheses are numbers of specimens examined. Complete collection locality data are available from the first author. CUMBERLAND R. DR.: Obey R.: KU 11512 (11); Wolf R. (Obey R. Dr.:): UMMZ 125463 (10), 125669 (2), 125678 (1), KU 11533 (25), USNM 204345 (10), UT 91.183 (2), TU 32849 (1); Kettle Cr.: UMMZ 125608 (1); Marrowbone Cr.: UMMZ 154638 (7); Crocus Cr.: UMMZ 177990 (10); Beaver Cr.: UMMZ 169479 (16); Fishing Cr.: INHS 75015 (6), UMMZ 169381 (3), 171603 (10); Pitman Cr.: UMMZ 168017 (10); Little S. Fk.: UMMZ 169489 (4), UT 91.452 (10), 91.665 (10); Rock Cr.: UT uncat. (16).

Diagnosis.—Etheostoma obeyense is distinguished from all other members of the subgenus by the following combination of characteristics: a bicolored bar on cheek; red and blue pigments on fins and head; caudal fin without distinct black vertical bands; infraorbital canal interrupted, with four pores anteriorly and usually two pores posteriorly (Fig. 2); 10 preoperculomandibular pores; no conspicuous dark longitudinal stripes on sides; no (or a weak) suborbital bar; adults (over 35 mm SL) with 12 or more pored lateral line scales; usually with 13 dorsal fin rays.

Comparisons.—Etheostoma smithi was contrasted earlier with *E. obeyense. Etheostona barbouri* has a strong suborbital bar, 12 or fewer pored lateral line scales, usually nine preoperculomandibular pores, three pores in the anterior segment of the infraorbital canal, and one pore in the posterior segment of the infraorbital canal. *Etheostoma virgatum* has conspicuous dark longitudinal stripes on the sides.

Description.—A moderate-sized *Catonotus* reaching 70 mm SL (about 33% larger than *E. smithi*); elongated with a terminal mouth, and a significantly longer snout (preorbital length) than that of *E. smithi.* Infraorbital canal interrupted (Fig. 2) with four pores anteriorly (96% of the specimens examined; N = 112) and usually two pores posteriorly (71%; N = 112); supratemporal canal interrupted medially with pores usually 2—2; usually 10, rarely

nine, preoperculomandibular pores; snout with a rather broad frenum; six branchiostegal rays on a side with the branchiostegal membranes separate or slightly fused; preopercle crenulate.

Head, nape to the origin of the first dorsal fin, breast, and prepectoral area unscaled; 39 to 56 lateral scales; 10 to 26 (usually 12 or more) pored lateral line scales in adults; 12 to 18 transverse scales from anal fin origin to first dorsal fin; 12 to 15 scales to the second dorsal fin; 16 to 22 (usually 19) scales around the caudal peduncle.

Eight to 10 (usually 9) dorsal fin spines, without knobs; second dorsal fin elongated with 12 to 15 (usually 13) rays; 13 to 16 (usually 14) branched caudal fin rays; 11 to 14 (usually 12) pectoral fin rays; usually 2 anal fin spines; 7 to 10 (usually 9) anal fin rays; 1 pelvic fin spine; 5 pelvic fin rays.

Body proportions: HL/SL, 0.20-0.35 ($\bar{X}$ = 0.32); HW/SL, 0.11-0.15 (0.14); BD/SL, 0.15-0.22 (0.18); CPD/SL, 0.08-0.14 (0.11); P1L/SL, 0.20-0.28 (0.25); PreDL/SL—males, 0.34-0.37 (0.35); PreDL/SL—females, 0.35-0.38 (0.37); PreOL/BD, 0.35-0.71 (0.44); D2L/D1L, 0.81-1.13 (0.95); IOW/HW, 0.28-0.44 (0.37); GW/PreOL, 0.67-1.17 (0.93); BD/AL—males, 0.49-0.63 (0.56); BD/AL—females, 0.58-0.79 (0.69); D2FL/QL—males, 0.85-0.99 (0.92); D2FL/QL—females, 0.73-0.86 (0.79); ED/HL, 0.20-0.50 (0.28); D1H/D1L, 0.31-0.73 (0.45); P2L/SL, 0.16-0.27 (0.21); ED/SL, 0.06-0.13 (0.09); CBW/PreOL, 0.43-0.66 (0.54).

Coloration in life: The coloration of *Etheostoma obeyense*, including that of the breeding male, is nearly identical to that of *E. smithi*. A subtle difference in *E. obeyense*, both in non-breeding individuals and breeding males, is a tendency for the mid-lateral pigment to be more concentrated into a series of squarish, but diffuse blotches, as opposed to the more vertically elongated blotches of *E. smithi* (Fig. 3).

Kuehne and Small (1971) included a color photo of a breeding male *E. obeyense* collected on 2 April 1969 and photographed one day later. Although the blue-black margins on the lower caudal, anal and lower pectoral fins are not shown, these dark margins are as characteristic of *E. obeyense* breeding males as of *E. smithi*. Several other collections of preserved breeding *E. obeyense* (including UMMZ 154638 and UT 91.665) retain the dark fin margins as described for *E. smithi*. Tubercles do not develop.

Variation.—Means of three of the 29 characteristics tested show highly significant (α = 0.005) sexual dimorphism. Males have smaller PreDL/SL and BD/AL ratios, and a larger D2FL/QL ratio than do females (Table 4). The sexual dimorphism in the PreDL/SL ratio is not expressed in *E. smithi*, and the dimorphism in the number of dorsal fin rays in *E. smithi* is not found in *E. obeyense* (although there is a significantly higher number in males than in females of *E. obeyense* at α = 0.05).

Means of six of the 29 characteristics tested showed highly significant variation among three different size classes (<35 mm SL, 35.1-40.0 mm SL, and >40 mm SL). Data for only the smallest and largest classes are shown in Table 5. Five of the six characteristics show the same pattern of variation as in *E. smithi;* larger *E. obeyense* have more pored lateral line scales and, relative to standard length, a shorter head, body depth, and eye diameter. In addition, larger *E. obeyense* have a shorter first dorsal fin height in relation to fin length. The ontogenetic variation in pelvic fin length expressed in *E. smithi* is not found in *E. obeyense.*

The two characters consistently showing ontogenetic variation in the three *Catonotus* species examined, *E. smithi, E. obeyense,* and *E. kennicotti* (Page and Smith 1976), are the number of pored lateral line scales and relative head length.

Geographic variation among characteristics examined is greater in *E. obeyense* than in *E. smithi* but also shows no clinal or other consistent pattern. The samples examined from Fishing Creek, Pulaski Co., Kentucky, and Rock Creek, Pickett Co., Tennessee, have especially high numbers of pored lateral line scales (Table 1) and pectoral fin rays ($\bar{X} = 12.9$ and 13.0, respectively; all other samples have means under 12.5). The samples from Marrowbone Creek, Cumberland Co., and Beaver Creek, Wayne Co., Kentucky, have especially low counts of pores in the posterior segment of the infraorbital canal (Table 2). The sample from Crocus Creek, Cumberland Co., Kentucky, has a high number of lateral scales ($\bar{X} = 51.4$; all other samples have means under 49.8).

Distribution and Habitat.—Etheostoma obeyense occurs in tributaries of the middle Cumberland River from the Obey River system east to tributaries of the Big South Fork (Fig. 4). The species generally is common in this rather restricted area of northcentral Tennessee and southcentral Kentucky, as first noted by Kirsch (1892) in the original description of the species.

Little ecological information is available on *E. obeyense* other than observations by Kuehne and Small (1971) that the species occurs in pools of 2nd, 3rd, and 4th order streams, and that of Comisky and Etnier (1972) that the species is common over sand in shallow water. We found *E. obeyense* to be most common in bedrock pools (in which crevices are occupied as hiding places by the darters) and in slabrock pools in small streams.

Relationships

No evidence of intergradation or of an east-to-west cline linking the two populations now regarded as *E. smithi* and *E. obeyense* was found. Such evidence would have suggested incomplete differentiation of the two populations.

Etheostoma smithi and *E. obeyense* are morphologically similar

species, allopatric but occupying the same river system (Fig. 4), and presumably have differentiated in relatively recent time. They have until now been considered to be one species. Recent examples of this misinterpretation are in a publication by Kuehne and Small (1971) in which their "Lower Cumberland *E. obeyense*" was actually *E. smithi,* and in a publication by Page (1975b) in which the "*E. obeyense*" on which spawning observations were made actually was *E. smithi.*

Reduced meristics, reductions in the lateralis system, and a smaller maximum body size are derived characteristics of darters. Thus, smaller numbers of pored lateral line scales and infraorbital canal pores, and the smaller maximum size of *E. smithi,* suggest that *E. smithi* is a derivative of *E. obeyense.* The only character found at variance with this evidence is a higher modal number of dorsal fin rays in *E. smithi* than in *E. obeyense.*

Other close relatives of *E. smithi* and *E. obeyense* are the other barcheek darters, *E. virgatum* and *E. barbouri,* and secondarily, the nonbarcheek species of *Catonotus, E. kennicotti* and *E. flabellare* (Page 1975b).

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Summary

Three species of barcheek darters (*Etheostoma virgatum, E. obeyense,* and *E. smithi*) occur in the Cumberland River system. *Etheostoma obeyense* Kirsch and *E. smithi,* herein described, are closely related but can be distinguished as follows: *E. obeyense* has four pores in the anterior segment of the infraorbital canal, usually two pores in the posterior segment of the infraorbital canal, 12 or more pored lateral line scales (in adults), modally 13 dorsal fin rays, and a mean PreOL/BD of 0.44; *E. smithi* has three pores

in the anterior segment of the infraorbital canal, one pore in the posterior segment of the infraorbital canal, 13 or fewer pored lateral line scales, modally 14 dorsal fin rays, and a mean PreOL/BD of 0.39. *Etheostoma obeyense* occurs in the middle Cumberland River system. *Etheostoma smithi* occurs in the lower Cumberland and lower Tennessee river systems.

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