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**THREE NEW SPECIES OF DARTERS (PERCIDAE,
ETHEOSTOMA) OF THE SUBGENUS *NANOSTOMA*
FROM KENTUCKY AND TENNESSEE****BY****LAWRENCE M. PAGE¹ AND BROOKS M. BURR²**

Among the freshwater fishes of North America are many recognized but taxonomically undescribed species. Some only recently have been discovered but many have been known for decades. The three species described herein have been recognized as distinct species for at least 30 years. Because undescribed species are known only to a few specialists, they do not receive the scientific attention given described species. For this reason, accentuated by the preparation of a book on Kentucky fishes (Burr, 1980), we herein name and describe *Etheostoma baileyi*, *E. rafinesquei*, and *E. barrenense*. We hope, as did Kuehne and Small (1971) and Bouchard (1977), that our action will promote descriptions of other well-known but undescribed North American fishes.

In describing *E. etnieri*, Bouchard (1977) diagnosed *Ulocentra* as a subgenus and discussed its close relationship to the subgenus *Etheostoma*. Later, because of the conclusion that *E. zonale* was more closely related to species of *Ulocentra* than to species of *Etheostoma* s.s., *Nanostoma* was recognized as a subgenus and *Ulocentra* was relegated to the synonymy of *Nanostoma* (Page, 1981). As diagnosed by Page (1981), *Nanostoma* contains five

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previously described species (*E. zonale*, *E. simoterum*,³ *E. duryi*, *E. coosae*, and *E. etnieri*), the three species described herein, and six or seven undescribed species.

With the exception of the wide-ranging *E. zonale*, all species of *Nanostoma* are limited to southern tributaries of the Ohio River, tributaries of the Mississippi River below the Ohio River, or Gulf of Mexico drainages in Mississippi, Alabama, Georgia, and western Florida. Most inhabit clear rocky pools of small to medium-sized streams. *Etheostoma zonale* occupies an extensive area of the Mississippi River system (Tsai and Raney, 1974) and has been introduced into the Susquehanna River (Atlantic drainage) in Pennsylvania (Denoncourt, et al., 1975).

METHODS

Counts and measurements follow Hubbs and Lagler (1964) except as follows. Transverse scales were counted from the anal fin origin to the first dorsal fin. Body depth was measured at the origin of the first dorsal fin. Pectoral and pelvic fin lengths were lengths of the longest rays. Interorbital width was least fleshy width. Number of lateral blotches was from opercle to caudal fin base. Head canal pore counts follow Hubbs and Cannon (1935).

Sample means and modes were compared for geographic variation. When significant variation was absent, samples were successively amalgamated by river system.

Etheostoma baileyi Page and Burr, new species

Emerald Darter

Holotype.—Illinois Natural History Survey 87484, an adult male 43.0 mm SL (Table 1) collected in Little Sexton Creek, tributary of South Fork Kentucky River, 2 km E (town of) Sextons Creek (37° 19'N, 83° 45'W), Clay County, Kentucky on 20 May 1980 by W. L. Keller, L. E. Cordes, and L. M. Page.

Paratypes.—A total of 56 specimens from South Fork Kentucky River system deposited as follows: 12—Illinois Natural History Survey (INHS 86871, 30-42 mm SL, same collection data as holotype); 9—The University of Kansas (KU 19109, 29-41 mm SL, same locality as holotype, 22 March 1978); 9—University of Tennessee (UT 91.2360, 28-42 mm SL, same collection data as KU 19109); 16—Southern Illinois University at Carbondale (SIUC 1026, 27-42 mm SL, Red Bird River, Eriline, Clay County, Kentucky, 28 October 1980); 10—University of Florida, Florida State Museum (UF 32481, 26-39 mm SL, same collection data as SIUC 1026).

³ *Etheostoma atripinne* is at most only intraspecifically distinct from *E. simoterum* (Etnier and Bouchard, *in manuscript*).

Material examined (but not designated as types).—Museum abbreviations are identified in ACKNOWLEDGMENTS. Numbers in parentheses are numbers of specimens on which counts or measurements were made. Complete collection locality data are available from the authors. KENTUCKY R. SYSTEM: INHS 78499 (1), 78513 (3), 78976 (1), 79029 (7), 79098 (1), 79197 (10), 86871 (10), KNPC KKo1LEE (4), KKo1LES (3), uncat. (Clemons Fork, Breathitt Co., KY, 10 Mar. 1979) (5); SIUC 1027 (7); UL 6015 (3), 7133 (1), 8051 (5), 11817 (4); UMMZ 177854 (10). CUMBERLAND R. SYSTEM: INHS 83897 (3); KNPC KCO1BEL (10), uncat. (Poor Fork, Harlan Co., KY, 22 June 1978) (3); SIUC 1028 (20), 1029 (1), 1030 (5), 1031 (3).

Etymology.—Named for Dr. Reeve M. Bailey, Curator Emeritus of Fishes, University of Michigan Museum of Zoology, in recognition of his outstanding contributions to systematic ichthyology. The common name, emerald darter, has been used for this species for decades (e.g., Kuehne and Bailey, 1961) and refers to the dominating color of the species.

Diagnosis.—Member of subgenus *Nanostoma* as diagnosed by Page (1981). As noted by Bouchard (1977) the most diagnostic features of this group of darters are color characteristics. *Etheostoma baileyi* is easily distinguished from all other darters by its body and dorsal fin pigmentation. Side of body with 7-11 (usually 9-10; Table 2) small emerald-green squares (some appear as W's when examined closely) subtending the lateral line; squares expanded dorsally and ventrally as lime-green bars in breeding male. Midline of dorsum with 7-10 (usually 8) emerald-green squares. First dorsal fin green in male, clear in female, with red margin and red spots on interradi al membranes; red margin usually restricted to distal one-fourth of fin except extends one-half way down height of fin in first two membranes and occupies all of last membrane. Without red or orange pigment except in first dorsal fin. Premaxillary frenum narrow but always present. Modally five branchiostegal rays (Table 2) and 10 preoperculomandibular pores (Table 3).

Unlike *E. baileyi*, all other taxonomically described species of *Nanostoma* have red in second dorsal fin of adult male, and all except *E. zonale* modally have nine preoperculomandibular pores.⁴ *Etheostoma baileyi* most closely resembles *E. zonale*, but *E. zonale* differs by having only six dark squares on middorsum, dark vertical bars rather than squares on side of body, and a more pointed snout.

Description.—Smallest member of subgenus; maximum SL = 47 mm for males, 43 mm for females. Snout extremely blunt; mouth small (Table 1) and subterminal. Body proportion values given

⁴ Modal count for *E. coosae* is nine, not 10 as given by Page (1981:18).

TABLE 1. Proportional measurements of three species of *Etheostoma* (*Nanostoma*), expressed as thousandths of SL.

Measurement	<i>E. rafinesquei</i> (N=30)				<i>E. barrense</i> (N=30)				<i>E. baileyi</i> (N=34)			
	holotype	range	$\bar{X}$	SD	holotype	range	$\bar{X}$	SD	holotype	range	$\bar{X}$	SD
Standard length	47.5	32.6-49.2	41.6	4.17	48.8	40.2-53.3	45.2	3.53	43.0	29.8-46.5	36.9	4.17
Head length	246	223-258	241	9.45	240	223-257	237	8.69	240	232-258	243	6.57
Head width	143	133-157	146	7.02	141	127-146	136	6.19	147	116-156	133	10.52
Interorbital width	44	34-54	44	4.63	51	35-57	45	4.90	49	35-57	47	5.44
Snout length	65	48-73	58	5.60	66	47-64	56	4.61	65	45-74	61	6.29
Eye diameter	61	62-75	69	4.27	59	57-70	65	4.17	60	51-65	60	4.18
Gape width	55	40-58	46	4.44	51	34-54	43	4.43	53	38-51	47	5.29
Predorsal length	305	290-322	306	7.07	326	272-327	304	14.34	314	292-333	316	7.36
Body depth	202	190-241	211	10.07	213	186-243	216	12.32	195	159-214	181	14.59
Caudal peduncle depth	99	92-110	99	4.63	102	86-111	97	6.18	112	84-127	100	8.69
Caudal fin length	213	186-227	206	10.37	197	186-228	205	11.33	195	169-229	200	14.64
Pelvic fin length	238	205-271	237	16.06	227	221-279	239	13.66	228	206-254	225	11.85
Pectoral fin length	280	260-315	282	14.26	264	249-314	278	14.41	286	237-299	277	15.77
Pelvic fin base length	34	29-47	38	4.03	29	31-51	39	5.77	33	26-41	33	4.28
Anal fin length ♂ ♂	265	224-286	253	14.75	264	249-299	269	14.77	228	210-273	240	20.24
Anal fin length ♀ ♀		217-254	231	10.53		214-257	234	11.16		211-257	235	12.13
Second dorsal fin length ♂ ♂	282	264-301	284	10.86	295	265-330	298	17.32	247	222-288	257	17.26
Second dorsal fin length ♀ ♀		230-280	245	11.45		231-266	250	10.87		232-270	248	12.75
First dorsal fin base length ♂ ♂	299	269-323	294	17.88	283	272-318	294	10.66	305	264-304	284	11.56
First dorsal fin base length ♀ ♀		263-301	278	14.75		264-306	284	13.12		258-297	281	11.44
Second dorsal fin base length ♂ ♂	196	164-194	179	9.11	197	172-206	192	9.81	156	143-187	166	10.82
Second dorsal fin base length ♀ ♀		140-184	162	14.50		141-184	163	14.82		146-176	163	8.66

TABLE 2.—Counts of lateral blotches and branchiostegal rays in three species of *Etheostoma* (*Nanostoma*).

Species & River	No. Blotches							No. Rays								
	7	8	9	10	11	N	$\bar{X}$	SD	CV	4	5	6	N	$\bar{X}$	SD	CV
<i>Etheostoma rafinesquei</i> -----	6	29	49	4		88	8.6	0.69	8.0		92		92	5.0	0.00	0
<i>Etheostoma barrenense</i> -----	4	39	54	4		101	8.6	0.64	7.4	2	90	1	93	5.0	0.18	3.6
<i>Etheostoma baileyi</i>																
Cumberland -----	1	5	14	4		24	8.9	0.74	8.3		39	6	45	5.1	0.34	6.7
Kentucky -----		2	10	16	4	32	9.7	0.78	8.1		62	3	65	5.0	0.21	4.2

TABLE 3.—Counts of infraorbital and preoperculomandibular pores in three species of *Etheostoma* (*Nanostoma*).

Species & River	No. Infraorbital Pores							No. Preoperculomandibular Pores									
	7	8	9	N	$\bar{X}$	SD	CV	8	9	10	11	N	$\bar{X}$	SD	CV	4	CV
<i>Etheostoma rafinesquei</i>	15	72	4	91	7.9	0.44	5.6	8	81	1		90	8.9	0.31	3.5		
<i>Etheostoma barrenense</i>	10	79	14	103	8.0	0.48	6.0	7	95	1		103	8.9	0.27	3.1		
<i>Etheostoma baileyi</i>																	
Cumberland	32	11		43	7.3	0.44	6.1		11	29	2	42	9.8	0.52	5.3		
Kentucky	20	27		47	7.6	0.50	6.6		12	40	4	56	9.9	0.52	5.3		

in Table 1 and shown in Fig. 1. Infraorbital canal with 7 or 8 pores (Table 3), preoperculomandibular canal with 9-11 (usually 10) pores (Table 3). Lateral line complete to end of hypural plate (56 specimens), or missing on 1 (15), 2 (21), 3 (10), 4 (9), 5 (6), 6 (1), 7 (1), or 10 (1) scales posteriorly. Genital papilla of breeding female long and tubular, equal in length to about one-half length of first anal spine; of male a short tube.

Breast unscaled; prepectoral area scaled. Belly fully scaled. Nape usually fully scaled, rarely unscaled anteriorly. Cheek and opercle one-half to fully scaled, scales often embedded. Lateral scales (= lateral-line scales) 45-56 (Table 4); transverse scales 12-18 (Table 5); scales above lateral line 4 (4 specimens), 5 (95), 6 (20), or 7 (1); scales below lateral line 6 (5), 7 (69), 8 (35), 9 (8), or 10 (2); scales around caudal peduncle 15-21 (Table 6). Dorsal fin spines 10-13 (Table 7); dorsal fin rays 10-12 (Table 7); pectoral fin rays 13 (1), 14 (61), 15 (56), or 16 (2); anal fin spines 2; anal fin rays 6 (9), 7 (91), or 8 (20); branched caudal fin rays 11 (1), 12 (2), 13 (5), 14 (14), 15 (34), or 16 (1); total vertebrae 38 (7), 39 (39), 40 (13), or 41 (4).

Color in life: Juveniles and females olive above, yellow below, with 7-11 small emerald-green squares along midside (subtending lateral line) and 7-10 emerald-green squares along middle of back. First middorsal square on anterior nape, second at origin of first dorsal fin, third under first dorsal fin, fourth at posterior end of first dorsal fin, fifth at origin of second dorsal fin, sixth under second dorsal fin, seventh on caudal peduncle, eighth at origin of caudal fin. Upper side with wavy dark green lines; lower side, belly, and breast without dark marks. Black preorbital bar extends onto upper lip. Black suborbital bar (teardrop) slants slightly posteriad ventrally. Postorbital bar reduced to a black spot behind eye and black dash on upper opercle. No medial black spot at base of caudal fin (as is common in darters) but usually a small submedial dark green blotch. First dorsal fin described above; second dorsal, pectoral, and caudal fins with light green-brown bands; anal and pelvic fins clear.

In breeding male (Fig. 1) lateral blotches expanded dorso-ventrally into bright green bars; first dorsal fin green with bright red margin and interradiat spots; second dorsal and caudal fins dusky yellow with green bases; cheek, opercle, and anal and pelvic fins green.

Distribution and Variation.—*Etheostoma baileyi* inhabits the upper Cumberland and upper Kentucky River systems (Fig. 2). In the Cumberland system below Cumberland Falls, *E. baileyi* is restricted to the Rockcastle River and Big South Fork. Above Cumberland Falls, *E. baileyi* is known only from Jellico Creek, Clear Fork, and the Cumberland River. Although common in the

TABLE 4.—Counts of lateral scales in three species of *Etheostoma* (*Nanostoma*).

Species & River	No. Scales																				N	$\bar{X}$	SD	CV
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56				
<i>Etheostoma rafinesquei</i>	4	9	36	48	15	2															114	39.6	0.99	2.5
<i>Etheostoma barrenense</i>						3	13	23	24	21	15	10	3								112	45.3	1.67	3.7
<i>Etheostoma baileyi</i>																								
Cumberland									1	1	10	6	6	9	7	4	1				45	49.1	1.90	3.9
Kentucky										2	3	7	7	11	12	13	11	5	2	1	74	50.9	2.22	4.4

**A****B****C**

FIG. 1.—(A) *Etheostoma baileyi* male, 43 mm SL, Little Sexton Creek, Clay Co., KY., 20 May 1980; (B) *E. rafinesquei* male, 41 mm SL, Nolin River, LaRue Co., KY., 19 May 1980; (C) *E. barrenense* male, 44 mm SL, Trammel Creek, Allen Co., KY., 13 April 1978.

Rockcastle River and elsewhere locally, *E. baileyi* is sporadically distributed and generally uncommon in the Cumberland system.

Etheostoma baileyi is more widespread and common in the Kentucky River system and is present in the Red River and the South, Middle, and North forks of the Kentucky River. It does not occur in the Dix River (*contra* Branson and Batch, 1974).

Etheostoma baileyi and another darter, *E. sagitta*, are the only fishes restricted in distribution to the Cumberland and Kentucky River systems (Jenkins, et al., 1972). Kuehne and Bailey (1961)

concluded that *E. sagitta* and *E. baileyi* entered the Kentucky system from the Cumberland as a result of stream capture. Jenkins, et al. (1972) postulated that *E. baileyi* entered the Cumberland from the Kentucky system. *Ericymba buccata*, common in the Kentucky system, present in the upper but not the lower Cumberland system, and absent in the Tennessee system, must have entered the Cumberland from the Kentucky system. Variation in *E. nigrum* suggests that it also entered the upper Cumberland from the Kentucky system (or the Big Sandy system) and differentiated into the endemic subspecies *E. n. susanae*, then re-invaded the upper Kentucky system which today contains *E. n. nigrum* x *susanae* intergrades (Starnes and Starnes, 1979). Variation in *Nocomis microgogon* also suggests transfers between upper Kentucky and upper Cumberland fishes (Lachner and Jenkins, 1971).

Whether the original transfer of *E. baileyi* and other darters was from the Kentucky to the Cumberland or *vice versa* is impossible to determine. However, *E. sagitta* and the blackfin darter, *Percina* (*Odontopholis*) species, both occur in the upper Kentucky system and in one other river (the Cumberland and Green rivers, respectively) in Kentucky and have as their only close relatives species restricted to the Missouri River system in Missouri. The Kentucky River was formerly a tributary of the upper Mississippi River (via preglacial Teays River), as was the Missouri River (Pflieger, 1971). This suggests that the darters first were in the Kentucky River and later invaded other streams. If so, *E. baileyi* and *E. nigrum* probably were included in the transfer which carried *E. sagitta* from the Kentucky system to the Cumberland system.

The only notable variation among characteristics examined in *E. baileyi* is between the Kentucky River and the Cumberland River populations. Kentucky River individuals have higher modal numbers of lateral blotches (Table 2) and infraorbital pores (Table 3), and more lateral scales (Table 4) and transverse scales (Table 5). In *E. sagitta* the reverse was found; almost all meristic counts were higher in the Cumberland River population (*E. s. sagitta*) than in the Kentucky River population (*E. s. spilotum*) (Kuehne and Bailey, 1961).

Habitat and Ecology.—*Etheostoma baileyi* occupies rock-bottomed, current-swept pools of small to large streams. Where populations are large some individuals are found in rock riffles, especially along the riffle margins. Individuals in breeding condition have been collected in late March (INHS 79197), April (INHS 78976), May (INHS 86871), and early June (UL 11817).

Etheostoma rafinesquei Burr and Page, new species
Kentucky Snubnose Darter

Holotype.—Illinois Natural History Survey 87488, an adult male

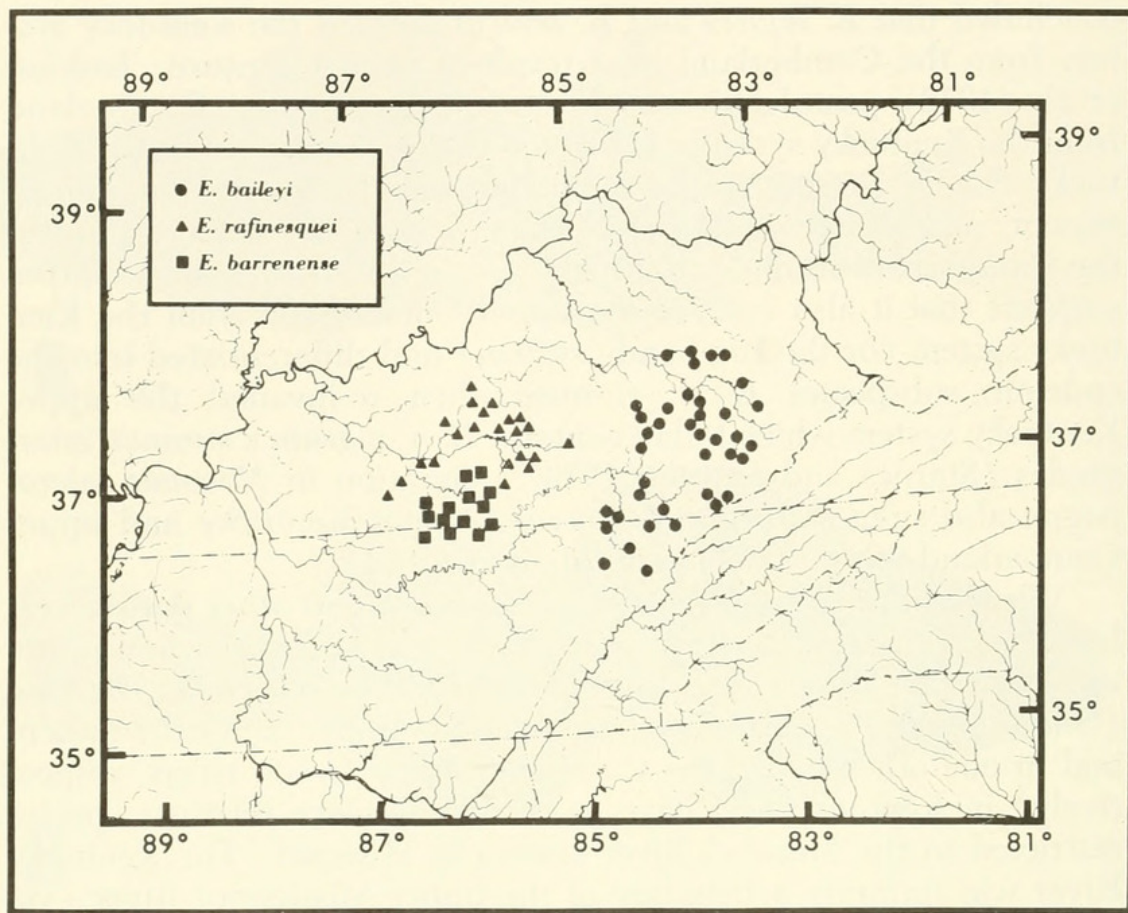


FIG. 2.—Distribution of localities from which *Etheostoma baileyi*, *E. rafinesquei*, and *E. barrenense* have been collected.

47.5 mm SL (Table 1) collected in Barren Run, tributary of North Fork Nolin River, 2 km NW (town of) Barren Run (37° 30'N, 85° 48'W), LaRue County, Kentucky on 29 May 1981 by B. M. Burr and L. M. Page.

Paratypes.—A total of 54 specimens collected with the holotype deposited as follows: 11—Illinois Natural History Survey (INHS 87482, 31-48 mm); 11—The University of Kansas (KU 19111, 31-48 mm SL); 11—University of Tennessee (UT 91.2359, 31-46 mm SL); 11—Southern Illinois University at Carbondale (SIUC 1025, 32-44 mm SL); and 10—University of Florida, Florida State Museum (UF 32482, 31-48 mm SL, same locality as holotype, 27 September 1980).

Material examined (but not designated as types).—GREEN R. SYSTEM: INHS 74849 (3), 75395 (7), 76034 (3), 79138 (1), 84058 (2), 86874 (5), 86878 (10); SIUC 1015 (1), 1016 (1), 1017 (10); UL 5262 (9), 5379 (2), 5712 (2), 5729 (3), 5801 (13), 5817 (2), 5981 (22), 10250 (1); UMMZ 177559 (10). BARREN R. SYSTEM: SIUC 1018 (7).

Etymology.—Named for Constantine S. Rafinesque, a pioneer naturalist and former Professor of Botany and Natural History, Transylvania University, Kentucky, who described 36 of Kentucky's

TABLE 5.—Counts of transverse scales in three species of *Etheostoma* (*Nanostoma*).

Species & River	No. Scales													N	$\bar{X}$	SD	CV
	10	11	12	13	14	15	16	17	18								
<i>Etheostoma rafinesquei</i> -----	13	36	65											114	11.5	0.69	6.1
<i>Etheostoma barrenense</i> -----			20	74	18									112	13.0	0.59	4.5
<i>Etheostoma baileyi</i> -----																	
Cumberland -----			1	9	25	9		1						45	14.0	0.84	6.0
Kentucky -----				4	34	20	14	2	1					75	14.7	1.01	6.9

presently recognized species of fishes. The common name, Kentucky snubnose darter, refers to the geographic domain of the species and its inclusion in the subgenus *Nanostoma*, generally referred to as snubnose darters. *Etheostoma rafinesquei* is the only fish restricted to Kentucky.

Diagnosis.—Member of subgenus *Nanostoma* as diagnosed by Page (1981). Distinguished from other taxonomically described species of *Nanostoma*, except *E. zonale*, by its low lateral scale count of 37-42 (usually 38-41; Table 4) and low transverse scale count of 10-12 (Table 5); *E. zonale* has 36-63 lateral scales and 9-19 transverse scales, other described species of *Nanostoma* have 42-61 lateral scales and usually 13 or more transverse scales although *E. duryi* has as few as 11 and *E. simoterum* as few as 12 (Tsai and Raney, 1974; Bouchard, 1977). Distinguished from *E. zonale* and all other darters by its body and median fin pigmentation. Side of body with 7-10 (usually 8-9; Table 2) dark bars 5-6 scale rows in height. Dorsum with 7-9 dark blotches; first blotch largest, covering 90% of nape, always extending posteriorly to origin of dorsal fin. Cross-hatched appearance on side of body created by dark (red-orange in breeding male) spots on posterior edges of scales on lower half of body and on 1-2 scale rows above lateral line. First dorsal fin with red spot in first interradi al membrane. Snout blue-green. Breeding male with blue-green lips, opercle, anal fin, and procurent caudal fin membranes; red-orange breast; red distally and basally on interradi al membranes of first dorsal fin; blue-green medially (and occasionally basally) on first 4-6 interradi al membranes of first dorsal fin; second dorsal fin red-purple medially. Premaxillary frenum present (narrow) in over 90% of specimens. Modally five branchiostegal rays (Table 2) and 9 preoperculomandibular pores (Table 3). Breast usually (69% of specimens) scaled posteriorly.

Other taxonomically described species of *Nanostoma* have greatly contrasting color patterns (Bouchard, 1977). *Etheostoma rafinesquei* most closely resembles *E. barrenense*, but *E. barrenense* has 43-50 lateral scales, shorter and wider lateral blotches that are confluent with a dark midlateral stripe, the first dorsal dark blotch confined to anterior half of nape, and an unscaled breast (95% of specimens).

Description.—Moderate-sized member of subgenus, maximum SL = 54 mm for males, 49 mm for females. Snout extremely blunt; mouth small (Table 1) and subterminal. Body proportion values given in Table 1 and shown in Fig. 1. Infraorbital canal with 7-9 (usually 8) pores (Table 3); preoperculomandibular canal with 8-10 (usually 9) pores (Table 3). Lateral line complete to end of hypural plate (112 specimens), or missing on 1(2) scale posteriorly. Genital papillae as in *E. baileyi*.

Breast unscaled in 27 specimens, variously scaled (to 50%) in

61 specimens; prepectoral area scaled. Belly, nape, and opercle fully scaled. Cheek unscaled (26) or fully scaled (64); scales often embedded. Lateral scales 37-42 (Table 4); transverse scales 10-12 (Table 5); scales above lateral line 3 (27) or 4 (68); scales below lateral line 5 (3), 6 (24), or 7 (67); scales around caudal peduncle 14-16 (Table 6). Dorsal fin spines 10-12 (Table 7); dorsal fin rays 9-13 (Table 7); pectoral fin rays 14 (68) or 15 (45); anal fin spines 1 (2) or 2 (97); anal fin rays 6 (8), 7 (74), or 8 (17); branched caudal fin rays 12 (3), 13 (32), 14 (33), or 15 (30); total vertebrae 38 (14), 39 (25), or 40 (5).

Color in life: Juveniles and females yellowish with 7-10 vertically elongated dark blotches along side, occasionally partly confluent with, but always extending well above and below a black lateral stripe. Dorsum with 7-9 square, vague to dark blotches. First blotch largest, covering 90% of nape; second and third under middle of first dorsal fin, fourth between dorsal fins, fifth and sixth under second dorsal fin, seventh on caudal peduncle, eighth at origin of caudal fin. Posterior edges of scales on side of body dark. Preorbital bar darker than snout, extending to upper lip. Black suborbital bar. Dark dashes behind eye on cheek and opercle. Pelvic and anal fins clear. Pectoral, second dorsal, and caudal fins with dusky bands on rays. First interradi al membrane of first dorsal fin with red spot; remaining interradi al membranes with dusky, sometimes reddish, dashes. First dorsal fin usually with a distal or subdistal dark band.

Breeding male (Fig. 1) brightly colored as described in Diagnosis with lateral blotches distinct and greatly expanded dorso-ventrally.

Distribution.—*Etheostoma rafinesquei* occurs in the upper Green and lower Barren River systems (Fig. 2). In the Upper Green River system it is most common in tributaries of the Nolin River and fairly common in the Little Barren River and Russell, Brush, Pitman, and Goose creeks. In tributaries of the Gasper River, a tributary of the Barren River, *E. rafinesquei* seems to be most common in headwaters, particularly Wiggington Creek, Logan County. Although *E. rafinesquei* and its sister species, *E. barrenense*, both inhabit the Barren system, they maintain allopatric ranges. Except for one upstream locality, *E. rafinesquei* is not known from the main channel of the Green River.

The Green River system supports 151 species of fishes, five of which are introduced and five of which are endemic. Two of the endemics, *E. barrenense* and *Moxostoma atripinne*, are restricted to the upper Barren system; two, *E. bellum* and *E. barbouri*, to the upper Green and upper Barren systems; and one, *E. rafinesquei*, to the upper Green and lower Barren systems. Two crayfishes, *Barbi-*

TABLE 6.—Counts of scales around caudal peduncle in three species of *Etheostoma* (*Nanostoma*).

Species & River	No. Scales												N	$\bar{X}$	SD	CV
	14	15	16	17	18	19	20	21								
<i>Etheostoma rafinesquei</i>	11	66	37										114	15.2	0.61	4.0
<i>Etheostoma barrenense</i>		14	38	51	9								112	16.5	0.82	5.0
<i>Etheostoma baileyi</i>																
Cumberland		3	3	12	13	11	2	1					45	18.0	1.33	7.4
Kentucky		2	5	19	20	22	7						75	17.8	1.20	6.7

TABLE 7.—Counts of dorsal spines and rays in three species of *Etheostoma* (*Nanostoma*).

Species & River	No. Spines										No. Rays									
	10	11	12	13	N	$\bar{X}$	SD	CV			9	10	11	12	13	N	$\bar{X}$	SD	CV	
<i>Etheostoma rafinesquei</i> -----	19	84	4		107	10.9	0.44	4.1			1	13	74	17	2	107	11.1	0.63	5.7	
<i>Etheostoma barrenense</i> -----	3	84	25		112	11.2	0.46	4.1				3	57	47	5	112	11.5	0.63	5.5	
<i>Etheostoma baileyi</i> -----																				
Cumberland -----	4	39	2		45	11.0	0.37	3.3				9	27	9		45	11.0	0.64	5.8	
Kentucky -----	11	55	8	1	75	11.0	0.56	5.1				28	46	1		75	10.6	0.51	4.8	

cambarus cornutus and *Orconectes barrenense*, are endemic to the upper Green and Barren systems.

Habitat and Ecology.—*Etheostoma rafinesquei* generally occupies second-, third-, and fourth-order upland streams where it is most common in rock- or gravel-bottomed pools. During fall and spring it is sometimes common in riffles or their margins, especially around emergent vegetation.

Winn (1958a, b) collected *E. rafinesquei* in breeding condition from South Fork Nolin River on 8 April 1953, transferred them to an aquarium, and observed spawning behavior. Stiles (1974) observed spawning in streams in the springs of 1971, 1972, and 1973. Eggs are laid singly on the sides of stones, usually with the spawning pair in a vertical position. *Etheostoma rafinesquei* in breeding condition has been collected as early as mid-March (INHS 76034) and as late as 25 May (SIUC 1020); most ripe individuals are in April collections.

Etheostoma barrenense Burr and Page, new species
Splendid darter

Holotype.—Illinois Natural History Survey 87491, an adult male 48.8 mm SL (Table 1) collected in Trammel Creek, tributary of Drakes Creek, 3 km SW Halfway (36° 48'N, 86°18'W) Allen County, Kentucky on 25 May 1981 by L. M. Page and B. M. Burr.

Paratypes.—A total of 44 specimens deposited as follows: 12—Illinois Natural History Survey (INHS 87492, 32-47 mm SL, same collection data as holotype); 7—The University of Kansas (KU 19110, 33-43 mm SL, Trammel Creek, 6 km SSW Scottsville, Allen County, Kentucky, 13 April 1978); 6—University of Tennessee (UT 91.2358, 37-42 mm SL, same collection data as KU 19110); 9—Southern Illinois University at Carbondale (SIUC 1009, 35-45 mm SL, Indian Creek, 4.8 km E Fountain Run, Monroe Co., Kentucky, 18 March 1980); 10—University of Florida, Florida State Museum (UF 32483, 32-44 mm SL, same collection data as SIUC 1009).

Material examined (but not designed as types).—BARREN R. SYSTEM: INHS 74879 (1), 75064 (10), 75468 (10), 75997 (7), 76871 (8), 77070 (2), 77514 (2), 79290 (10), 82653 (2), 84050 (3), 84057 (2); SIUC 1009 (10), 1011 (2), 1013 (2), 1010 (5); UL 5187 (7), 5364 (10), 5648 (1); UMMZ 177622 (10).

Etymology.—The name *barrenense* is an adjective referring to the Barren River to which the new species is endemic. The common name, splendid darter, alludes to the bright colors of the breeding male and has been used by ichthyologists for this species for many years.

Diagnosis.—Member of subgenus *Nanostoma* as diagnosed by Page (1981). Distinguished from other described members of sub-

genus by body and median fin pigmentation. Side of body with 7-10 (usually 8-9; Table 2) round to square black blotches always confluent with a midlateral dark stripe; blotches not elongated dorsoventrally on breeding male. Dorsum with 7-9 (usually 8) dark blotches, the first confined to anterior half of nape. First dorsal fin with red spot in first interradi al membrane. Snout green. Breeding male with bright blue anal and pelvic fins and procurent caudal fin membranes; red-orange breast; red on lower side, and in a thin stripe above midlateral stripe; red distally and medially on interradi al membranes of first dorsal fin; black or green basally on first eight membranes of first dorsal fin; second dorsal fin red-purple medially and, on posterior half, basally. Premaxillary frenum narrow but always present. Modally five branchiostegal rays (Table 2) and nine preoperculomandibular pores (Table 3). Breast usually unscaled (95% of specimens).

Most similar to *E. rafinesquei* (see Diagnosis for *E. rafinesquei*). *Etheostoma duryi* has broad black stripe along side but lacks a premaxillary frenum, and the breeding male lacks red pigment above and below black lateral stripe and bright blue in anal, caudal, and pelvic fins.

Description.—Moderate-sized member of subgenus, maximum SL = 53 mm for males, 47 mm for females. Snout extremely blunt; mouth small (Table 1) and subterminal. Body proportion values given in Table 1 and shown in Fig. 1. Infraorbital canal with 7-9 (usually 8) pores (Table 3); preoperculomandibular canal with 8-10 (usually 9) pores (Table 3). Lateral line complete to end of hypural plate (104 specimens) or missing on 1 (5), 2 (2), or 4 (1) scales posteriorly. Genital papillae as in *E. baileyi*.

Breast unscaled (97 specimens), with 2 scales (2), 10% scaled (2), or 40% scaled (1); prepectoral area scaled. Belly, nape, and opercle fully scaled. Cheek unscaled (6) or fully scaled (96); scales often embedded. Lateral scales 42-49 (Table 4); transverse scales 12-14 (Table 5); scales above lateral line 3 (2), 4 (99), or 5 (10); scales below lateral line 6 (1), 7 (26), 8 (79), or 9 (5); scales around caudal peduncle 15-18 (Table 6). Dorsal fin spines 10-12 (Table 7); dorsal fin rays 10-13 (Table 7); pectoral fin rays 13 (15), 14 (87), or 15 (10); anal fin spines 2; anal fin rays 6 (9), 7 (59), or 8 (44); branched caudal fin rays 12 (1), 13 (22), 14 (46), or 15 (42); total vertebrae 38 (11), 39 (32), or 40 (5).

Color in life: Juveniles and females yellowish with 7-10 round to square black blotches along side always confluent with a lateral black stripe. Blotches extend only slightly below, rarely above, lateral stripe. Dorsum with 7-9 (usually 8) vague to dark, round to square blotches; first blotch confined to anterior half of nape, second under origin of first dorsal fin, third and fourth under first dorsal fin, fifth and sixth under second dorsal fin, seventh on caudal

peduncle, and eighth at origin of caudal fin. Centers and edges of body scales above lateral stripe dark. Preorbital bar usually poorly developed, but extending to upper lip. Suborbital bar reduced to a dusky dash, occasionally absent. Dark dashes behind eye on cheek and opercle. Pectoral, pelvic, and anal fins clear. Second dorsal and caudal fins with dusky bands on rays. First dorsal fin with red spot in first interradi al membrane and occasionally with red spots on margin. Snout green. Upper half of cheek and opercle olive-green. Posterior half of body with red specks above and below lateral stripe.

Breeding male (Fig. 1) brightly colored as described in Diagnosis.

Distribution.—*Etheostoma barrenense* is restricted to the upper Barren River system in Kentucky and Tennessee (Fig. 2). It is common, especially in Drakes Creek, Trammel Creek, Beaver Creek, Peter Creek, Long Fork, Fallen Timber Creek, Bays Fork, and East Fork Barren River. The only other fish species endemic to the Barren River is the highly distinctive *Moxostoma atripinne*.

Habitat and Ecology.—*Etheostoma barrenense* occurs commonly in pools, and occasionally along the margins of riffles and raceways over limestone bedrock, clean gravel, or around large rocks. It occupies second-, third-, and fourth-order streams.

Winn (1958a, b) collected *E. barrenense* in breeding condition, made field observations on territoriality and spawning in April 1953 and April 1954, and observed spawning in an aquarium. Stiles (1974) observed courtship and spawning in streams in the springs of 1971, 1972, and 1973. Spawning occurs in a vertical position; eggs are laid on the sides of rocks. Breeding specimens are present in collections made as early as 18 March (SIUC 1009) and as late as 17 June (INHS 75064) but are most prevalent in collections made in April and May.

RELATIONSHIPS

Relationships among species of *Nanostoma* are difficult to decipher because published morphological data on the remaining undescribed species are scarce to nonexistent, differentiating characteristics among species are predominantly color features which are highly variable, and speciation appears to have been recent and characteristics clearly recognizable as synapomorphies are rare.

The one clearly synapomorphous character state among *Nanostoma* is a mode of only five branchiostegal rays; a mode of six rays in *E. coosae* (and in most other *Etheostoma*) separates it as a sister group to other species of *Nanostoma*. Unfortunately a few populations of *E. zonale* modally have six branchiostegal rays, confusing the phylogenetic relationships of *E. zonale* to other species of *Nanostoma*. Other character states recognized as derived within

Nanostoma but also shared with species outside the subgenus *Nanostoma* are a mode of nine preoperculomandibular pores (10 in *E. zonale* and *E. baileyi*), mode of eight dorsal dark blotches (*E. zonale* has six), absence of prevomerine teeth (present in *E. coosae* and *E. zonale*), and loss of scales on the breast (variable in *E. zonale*, present posteriorly in *E. etnieri* and *E. rafinesquei*).

The loss of the premaxillary frenum is a derived state but too much intraspecific variation occurs for the characteristic to impart much phylogenetic information. Likewise the presence in some species of a red spot anteriorly in the first dorsal fin is difficult to interpret phylogenetically; in some species it is a distinct spot (*E. simoterum*), but in others is expanded dorsoventrally (*E. baileyi* and *E. duryi*) or is part of a red band (*E. coosae* and *E. rafinesquei*). Other color characteristics are equally or more difficult to relate to one another, although phylogenetic patterns may become more clear when the remaining six or so recognized but undescribed species are described. For now, all that is apparent is that *E. coosae*, *E. zonale*, and *E. baileyi* are early offshoots from the main line of evolution in *Nanostoma*, and that all other species probably are more closely related to one another than to these three species.

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SUMMARY

Three new species of the subgenus *Nanostoma* are described. *Etheostoma baileyi* inhabits the upper Cumberland and upper Kentucky River systems, Kentucky and Tennessee, and is distinguished from other darters by its pigmentation, especially the row of small emerald green squares along the side and the red margin and interradiated red spots on the first dorsal fin. *Etheostoma rafinesquei*, in the upper Green and lower Barren River systems, Kentucky, is distinguished from other species of *Nanostoma* except *E. zonale* by its low lateral scale count, and from all darters by the combi-

nation of a series of dark bars along the side of the body, a cross-hatched appearance created by dark (red-orange in breeding male) spots on the posterior edges of lateral scales, and modally five branchiostegal rays and nine preoperculomandibular pores. *Etheostoma barrenense*, in the upper Barren River system, Kentucky and Tennessee, is distinguished by having modally five branchiostegal rays and nine preoperculomandibular pores, a series of dark blotches along the side strongly confluent with a midlateral stripe, and, in the breeding male, red on the lower side and in a thin stripe above the midlateral stripe, and bright blue anal and pelvic fins.

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