



***Etheostoma erythrozonum*, a new species of darter (Teleostei: Percidae) from the Meramec River drainage, Missouri**

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Abstract

A new species of darter, *Etheostoma erythrozonum*, is described from the Meramec River drainage of Missouri, USA. *Etheostoma erythrozonum* is the first known fish species endemic to the Meramec River drainage. It differs morphologically and genetically from populations of its sister species, *Etheostoma tetrazonum*, from the Gasconade River, Osage River, and Moreau River drainages.

Key words: darter, Percidae, *Etheostoma*, *Etheostoma erythrozonum*, *Etheostoma tetrazonum*, Meramec River, Missouri, Ozarks

Introduction

Etheostoma tetrazonum (Hubbs and Black), the Missouri Saddled Darter, is one of several darter species endemic to the northern Ozark region of Missouri. *Etheostoma tetrazonum* was described as a member of the *Etheostoma variatum* species group (Hubbs & Black, 1940) and is now classified as a member of subgenus *Poecilichthys* (Page, 2000). The type locality designated for *E. tetrazonum* is the Big Niangua River at the mouth of Greasy Creek, a tributary of the Osage River drainage. Specimens of *E. tetrazonum* were also identified from the Gasconade River system in the description. Both the Osage and Gasconade rivers are tributaries of the Missouri River. At the time of its description, *E. tetrazonum* was only known to exist in the Osage and Gasconade River systems. However, within a year of its description, individuals of *E. tetrazonum* were identified from the Meramec River system, a tributary of the Mississippi River. Since then the distribution of *E. tetrazonum* has been considered to include the Meramec, Gasconade, Osage, and Moreau River systems (Pflieger, 1971, 1997). The Moreau River is a tributary of the Missouri River.

An electrophoretic analysis of the *Etheostoma variatum* species group by McKeown *et al.* (1984) revealed considerable genetic divergence between populations of *Etheostoma tetrazonum* from the Meramec and Osage River drainages. This was the first evidence indicating that *E. tetrazonum* may represent more than one species. A recent molecular phylogenetic analysis of 13 populations of *E. tetrazonum* indicates that populations previously identified as *E. tetrazonum* represent two species. This conclusion is based on the resolution of these populations as two, well supported and reciprocally monophyletic groups: one comprised of individuals from the Moreau, Osage, and Gasconade River drainages; the other comprised of individuals from the Meramec River drainage (Switzer & Wood, 2002). The purpose of this study is to describe the morphological variation that exists between these species and provide a description of the first species of fish endemic to the Meramec River.

Materials and methods

Morphological data was collected directly from specimens. Photographs of type materials were taken in the field using Fuji Provia 100 ISO film. Scale and fin ray counts were based on the methods of Hubbs & Lagler (1958). All measurements are given in millimeters. Institutional abbreviations follow Leviton *et al.* (1985) and Leviton & Gibbs (1988). Type materials were deposited in the following institutions: United States National Museum of Natural History (USNM); University of Alabama Ichthyology Collection (UAIC); University of Minnesota Bell Museum of Natural History (JFBM).

The following specimens were used for meristic comparisons:

Etheostoma tetrazonum: **Missouri: Laclede County:** UAIC 15270.01 (6, 51–57) Osage Fork at Highway 32, Dry Knob access, 5 April 1996. CU 37354 (12, 47–66) Gasconade River, 28 March 1961. UAIC 15271.01 (13, 48–69) Osage Fork at County Road B, 4 mi south of Lebanon (37° 35.302N; 92° 30.856W), 2 April 2001. **Texas County:** UAIC 10362.03 (6, 59–68) Roubidoux Creek, 22 August 1991. UAIC 15272.01 (5, 59–69) Big Piney Creek at Co. Rd. BB (37° 27.57; 91° 59.33), 20 April 2000. **Wright County:** UAIC 10364.02 (22, 48–70) Gasconade River, 23 August 1991. **Pulaski County:** UAIC 7989.11 (13, 52–62) Big Piney River, 20 October 1987. **Dallas County:** UAIC 15273.01 (20, 46–56) Niangua River at CR.K-161, Big John Access (37° 38.53N; 93° 2.67W), 21 April 2000. **Miller County:** UMMZ 152754 (13, 45–62) Tavern Creek, 14 September 1940. **Polk County:** UMMZ 150094 (20, 45–53) Little Sac River, 1 July 1940. **Hickory County:** KU 7537 (8, 45–58) Pomme de Terre River, 6 April 1963. **Cole County:** UAIC 15274.01 (23, 44–51) South Moreau River at Vaughn Ford Rd, 12 July 2000.

Etheostoma erythrozonum, new species

Meramec Saddled Darter

Figure 1

Holotype. USNM 391646, male, 67 mm SL, Huzzah Creek at the Reis Biological Station, 6.2 km upstream from the Route 8 bridge (37° 56.871'N; 91° 10.676'W), Crawford County, Missouri, 3 April 2003.

Paratypes. Missouri, Crawford County. USNM 391647, (3, 55–67 mm SL), taken with holotype. JFBM 45691, (3, 51–66 mm SL), taken with holotype. JFBM 45692, (6, 48–71 mm SL), same locality, 1 June 2001. UAIC 15267.01, (7, 46–71 mm SL), same locality, 1 June 2001.

Additional materials (nontypes).

Missouri: Crawford County: UAIC 15268.01 (10, 57–77) Meramec River at Scotts Ford Access, 6 April 1996. CU 34444 (12, 48–71) Courtois Creek at Walter Diggs Farm, 2 mi. downstream from Butts, 26 August 1959. **Dent County:** UMMZ 149516 (10, 49–64) Meramec River, 2 mi. NW of Short Bend, 23 August 1941. **Franklin County:** KU10141 (8, 45–54) Bourbeuse River at Noser Mill, 11 July 1963. UAIC 7938.17 (11, 50–66) Meramec River at Meramec State Park, 21 October 1987. UAIC 15269.01 (4, 47–60) Meramec River at Robertsville State Park (38° 26.13'N; 90° 49.49'W), 1 April 2000. **St. Francois County:** CU 63065 (10, 47–53) Big River below Route K bridge, 3 mi. east of Bonne Terre, 22 Aug 1967. **Washington County:** JFBM 45693 (7, 53–75) Big River at Missouri Department of Conservation Bootleg Access, 10 mi. south of Potosi (37° 48.765'N; 90° 46.332'W), 3 October 1999.

Diagnosis. Member of subgenus *Poecilichthys* as defined by 4–6 dark saddles on back and upper sides, saddles angled obliquely forward; breeding tubercles on males and females; in males tubercles well developed on scales of the breast, lower side anterior to the anal fin, along the anal fin, and ventral scales of the caudal peduncle, enlarged ridges along anal fin rays; in females tubercles occasionally present on ventral scales; complete lateral line; no interruptions in head canals; broadly joined branchiostegal membranes; 6 branchiostegal rays; long tubular genital papilla in the female; premaxillary frenum present; 2 anal spines.

Distinguished from other species of *Poecilichthys* by 4 dark saddles on back and upper sides (vs. 5 or 6 in *E. kanawhae* and *E. osburni*), scales on breast (vs. unscaled in *E. kanawhae* and *E. osburni*), the absence of

blue on the body (vs. blue present in *E. tetrazonum* and *E. variatum*), and prominent red-orange blotches on body (vs. small orange spots in *E. euzonum*).



FIGURE 1. *Etheostoma erythrozonum* (A) male 67 mm SL, holotype USNM 391646 and (B) female 64 mm SL, paratype USNM 391647. Huzzah Creek at the Reis Biological Station, 6.2 km upstream from the Route 8 bridge, Crawford County, Missouri, 3 April 2003.

Most similar to *E. tetrazonum* but distinguished by the lack of blue-green on the body, a prominent feature of *E. tetrazonum*; presence in males of a horizontal red-orange stripe extending along the lower sides from the pelvic fins to the anal fin with an irregular dorsal margin vs. dorsal stripe with a well-defined dorsal margin in *E. tetrazonum*; and a series of red-orange blotches that are irregular in shape from the anal fin to the base of the caudal fin, vs. well defined vertical bars in *E. tetrazonum*. The spinous dorsal fin of male *E. erythrozonum* usually lacks the broad blue base present on *E. tetrazonum*; if present, the blue is relatively inconspicuous. The anal fin of *E. erythrozonum* is blue-green with red-orange spots forming two horizontal rows across the fin; red-orange spots are rarely observed on the anal fins of *E. tetrazonum*, and never to the extent present in *E. erythrozonum*. The modal number of dorsal-fin spines is 13 in *E. erythrozonum*, 12 in *E. tetrazonum* (Table 4). The modal number of pectoral-fin rays is 16 in *E. erythrozonum*, 15 in *E. tetrazonum* (Table 7).

Description. *Etheostoma erythrozonum* is a relatively large, stout-bodied species of *Etheostoma*. Frequency distributions of scales, spines and fin rays given in Tables 1–8. Dorsal-fin spines (11–14, modally 13), dorsal-fin rays (12–14, modally 13), anal-fin rays (8–10, modally 9), principal caudal rays (16–18,

modally 17), pectoral-fin rays (15–17, modally 16), lateral-line scales (39–55, modally 50), cheek scales absent, opercle partially scaled (0–9 scales, modally 5), breast partially to completely scaled, nape completely scaled. Both males and females of this species have four prominent dark saddles on the back and dorsal sides, with the sides angled obliquely forward. The background color is dusky in the dorsal region, lighter in the sublateral region and white on the belly. Along the sides is a series of sub-lateral dark blotches. There is a dark preorbital bar extending forward and a dark suborbital bar extending down the cheek. This species exhibits extreme sexual dimorphism in nuptial color patterns.

TABLE 1. Lateral-line scale counts for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Lateral-line scales																		N	-			
	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56			57	58	
<i>E. erythrozonum</i>	1				1			5	13	16	12	20	6	2	3	1	1					81	48.9
<i>E. tetrazonum</i>						1	4	4	6	14	21	15	20	21	17	20	11	5			1	160	51.1

TABLE 2. Transverse scale rows from anal-fin insertion to spinous dorsal-fin for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Transverse Scales								N	-
	14	15	16	17	18	19	20			
<i>E. erythrozonum</i>		7	43	22	9	1			82	16.4
<i>E. tetrazonum</i>	9	36	81	30	2	2	0		160	15.9

TABLE 3. Least scale rows around caudal peduncle for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Caudal Peduncle Scales								N	-
	18	19	20	21	22	23	24	25		
<i>E. erythrozonum</i>		2	1	12	18	43	5	1	82	22.4
<i>E. tetrazonum</i>	2	4	11	48	48	44	3		160	21.8

TABLE 4. Dorsal-fin spine counts for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Dorsal-fin spines						N	-
	10	11	12	13	14			
<i>E. erythrozonum</i>		1	11	61	9		82	13.0
<i>E. tetrazonum</i>	1	35	109	14	1		160	11.9

TABLE 5. Dorsal-fin ray counts for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Dorsal-fin rays					N	-
	12	13	14	15			
<i>E. erythrozonum</i>	3	61	18			82	13.2
<i>E. tetrazonum</i>	8	101	50	1		160	13.3

Males are characterized by the presence of a horizontal red-orange stripe extending along the lower sides from the pelvic-fins to the anal-fin. This stripe has an irregular dorsal margin. The ventral-lateral stripes are not confluent across the belly, which is white. From the anal-fin to the base of the caudal-fin the red-orange stripe continues as a series of separate, red-orange blotches that are irregular in shape. The sides are also covered by smaller, irregularly shaped red-orange spots, and there is no blue-green on the body. The spinous dorsal-fin is dark at the base, followed by a clear band, a dusky blue band, a clear band, a red band and a clear margin. The rayed dorsal-fin generally has a dusky base and has numerous red-orange spots on the rays, forming many horizontal rows across the fin. The membranes of the rayed dorsal-fin can become very dusky in males of peak breeding condition. In general the rayed dorsal-fin lacks blue, however some specimens have a faint blue wash at the base. The anal-fin is blue with red-orange spots forming two horizontal rows across the fin. There is a blue wash on the ventral margin of the caudal-fin. Pectoral-fins are generally clear with a slight yellow hue, and a series of red-orange spots. During the breeding season the membrane between pectoral-fin rays are dusky. Pelvic-fins are blue-black, with red-orange spots in some specimens. The branchiostegal rays are broadly connected and red-orange in coloration. Nuptial tubercles are well developed on scales of the breast, lower side anterior to the anal-fin, scales along the anal-fin, ventral scales of the caudal peduncle, and enlarged ridges are present along anal-fin rays.

Females of *Etheostoma erythrozonum* are muted in their color pattern compared to males. The branchiostegal membranes are white with orange spots; the sides are covered with small, irregularly shaped red-orange spots; the spinous dorsal-fin is dark at the base, followed by a clear band, a dusky band, a clear band, a faint orange band, and a clear margin; the rayed dorsal-fin has a dusky stripe at the base, clear membranes, and orange spots along the rays; pectoral-fins are generally clear with a series of faint orange spots; the pelvic-fins are generally unpigmented, occasionally with faint orange spots. Nuptial tubercles are occasionally present, but poorly developed on ventral scales, and ridges are not present on anal-fin rays. The female genital papilla is a long tube.

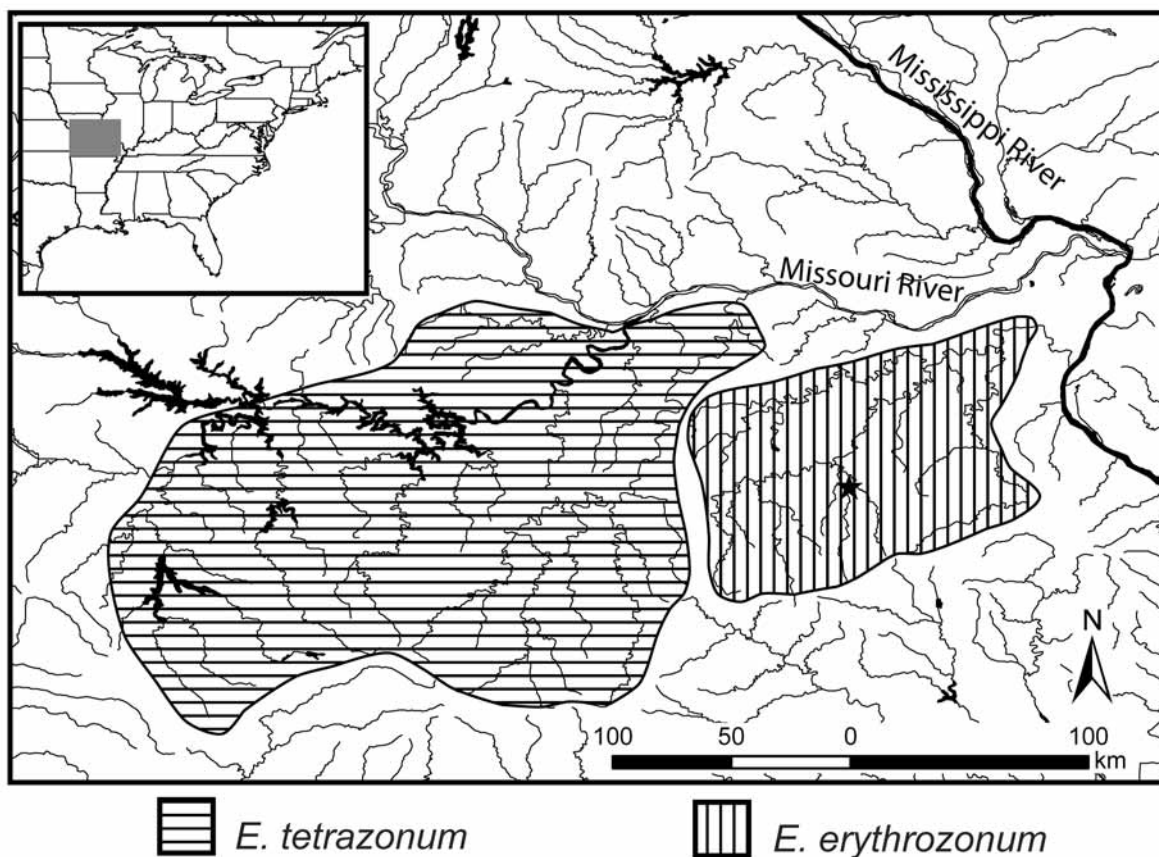


FIGURE 2. Distribution of *Etheostoma erythrozonum* (vertical lines) and *E. tetrazonum* (horizontal lines) in Missouri. The type locality of *E. erythrozonum* is identified with a star.

Comparisons. Observation of male nuptial color patterns across the ranges of *E. erythrozonum* and *E. tetrazonum* revealed considerable dissimilarities. Males of *E. tetrazonum* are characterized by the presence of a horizontal red-orange stripe extending along the lower sides from the pelvic-fins to the anal-fin. This stripe has a well-defined dorsal margin. The ventral-lateral stripes are not confluent across the belly, which is white. Seven vertical red-orange bars are evenly spaced from the posterior extent of the horizontal red-orange stripe to the base of the caudal-fin. Often the first vertical red-orange bar is continuous with the horizontal red-orange stripe. Between the vertical red-orange bars are blue-green vertical bars. A blue-green patch extends from the region just posterior to the pelvic-fin insertion up the side and around the pectoral-fin and onto the operculum and cheek. The second dorsal-fin is blue-green across the base with orange spots on the fin rays forming several horizontal rows across the fin. The anal-fin is blue-green with a clear margin and is without any orange spots in most specimens.

In contrast, males of *E. erythrozonum* have a horizontal red-orange stripe extending along the lower sides from the pelvic-fins to the anal-fins with an irregular dorsal margin. From the anal-fin to the base of the caudal-fin the red-orange stripe continues as a series of separate, red-orange blotches that are irregular in shape, not well defined vertical bars as in *E. tetrazonum*. *Etheostoma erythrozonum* lacks any blue-green on the body, a prominent feature of *E. tetrazonum*. The spinous dorsal-fin of male *E. erythrozonum* lacks the broad blue base present on *E. tetrazonum*, and if present, the blue is relatively inconspicuous. The anal-fin of *E. erythrozonum* is blue-green with red-orange spots forming two horizontal rows across the fin; red-orange spots are rarely observed on the anal-fins of *E. tetrazonum*, and never to the extent present in *E. erythrozonum*.

Examination of meristic data revealed two counts that differed between *E. erythrozonum* and *E. tetrazonum*. The modal number of dorsal-fin spines was 13 in *E. erythrozonum*, while it was 12 in *E. tetrazonum* (Table 4). The pectoral-fin ray count differed between these species, with a modal number of 16 in *E. erythrozonum* and 15 in *E. tetrazonum* (Table 7).

TABLE 6. Anal-fin ray counts for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Anal-fin rays					N	-
	8	9	10	11	12		
<i>E. erythrozonum</i>	2	70	10	82	9.1		
<i>E. tetrazonum</i>	1	143	16	160	9.1		

TABLE 7. Pectoral-fin ray counts for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Pectoral-fin rays					N	-
	14	15	16	17	18		
<i>E. erythrozonum</i>		29	50	2	81	15.7	
<i>E. tetrazonum</i>	24	96	39	1	160	15.1	

TABLE 8. Opercle scale counts for *Etheostoma erythrozonum* and *E. tetrazonum*.

	Opercle scales														N	-	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13			14
<i>E. erythrozonum</i>	1	2	2	10	15	27	12	5	6	2						82	4.9
<i>E. tetrazonum</i>	7	7	16	41	43	21	11	7	5	1					1	160	3.9

A phylogenetic analysis of cytochrome *b* sequence data from across the range of *E. tetrazonum* by Switzer & Wood (2002) recovered *E. tetrazonum* and the populations described herein as *E. erythrozonum* as two well supported, reciprocally monophyletic groups. The average uncorrected sequence divergence between populations of *E. erythrozonum* and *E. tetrazonum* was 7.2%.

Distribution. *Etheostoma erythrozonum* is restricted to the Meramec River drainage of Missouri (Figure 2). It is widely distributed within the Meramec River drainage, known from the main channel of the Meramec River in St. Louis County and upstream into larger tributaries. It is generally absent from small headwater streams.

Conservation status. *Etheostoma erythrozonum* is one of the most abundant darters within its range; its conservation status is currently considered stable (Warren *et al.*, 2000).

Etymology. The name *erythrozonum* is derived from Greek: *erythros*, red, and *zona*, zone. This name is in reference to the red-orange stripe and lateral red-orange blotches characteristic of this species, and the name is in keeping with the names of the other western members of subgenus *Poecilichthys*, ending in *-zonum*. The common name, Meramec Saddled Darter, is in reference to the Meramec River drainage, the range of this species, and the prominent dorsal saddles.

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