

OCCASIONAL PAPERS OF THE MUSEUM OF
ZOOLOGY
THE UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN

ETHEOSTOMA (ULOCENTRA) FLAVUM, A NEW DARTER FROM
THE TENNESSEE AND CUMBERLAND RIVER DRAINAGES

DAVID A. ETNIER* AND REEVE M. BAILEY†

ABSTRACT.—*Etnier, D. A. and R. M. Bailey, 1989. Etheostoma (Ulocentra) flavum, a new darter from the Tennessee and Cumberland river drainages. Occ. Pap. Mus. Zool. Univ. Michigan, 717:1-24, figs. 1-2, pl. 1. Etheostoma flavum, the saffron darter, is described from the lower Cumberland and lower Tennessee river drainages of Kentucky and Tennessee; it is common in the area, and the distribution is mapped. It differs from the often sympatric E. (Ulocentra) simoterum in lacking a premaxillary frenum, having a more produced snout, often having vomerine teeth, having a single rather than paired basicaudal dark spots, and in other aspects of pigmentation. It is similar to and occasionally sympatric with E. (Ulocentra) duryi, but differs in having orange lips and green basicaudal areas in life, in dorsal fin pigmentation of adult males, and in counts of dorsal plus lateral blotches and soft dorsal fin rays. Populations of Etheostoma flavum from the Indian Creek system, Tennessee, and a small area of the upper Duck River system, Tennessee, show evidence of past introgressive hybridization with E. duryi.*

INTRODUCTION

The darter described herein was first recognized as a new species by Carl L. Hubbs in 1930, and has been recognized by a number of ichthyologists since. The exact geographic distribution and its status relative to the intimately related *Etheostoma duryi* Henshall have been poorly understood. This study indicates that this species is distinct

*Department of Zoology, University of Tennessee, Knoxville, TN 37996-0810.

†Museum of Zoology, The University of Michigan, Ann Arbor, MI 48109-1079.

from *E. duryi*, but that the two taxa hybridize introgressively in their currently very limited area of geographical contact.

MATERIALS AND METHODS

Specimens of the new species and comparative material of *Etheostoma duryi* used are primarily from the collections at the University of Michigan Museum of Zoology (UMMZ) and the University of Tennessee (UT). Additional critical material has generously been provided by John S. Ramsey, formerly of Auburn University (AUM); Joseph T. Collins, University of Kansas (KU); Neil H. Douglas, Northeastern Louisiana University (NLU); Brooks M. Burr, Southern Illinois University at Carbondale (SIUC); Royal D. Suttkus, Tulane University (TU); Charles F. Saylor, Tennessee Valley Authority (TVA); and Herbert T. Boschung, University of Alabama (UAIC).

Counts and measurements were made as described in Hubbs and Lagler (1958) except as mentioned below. Some vertebral counts for both *E. flavum* and *E. duryi* were graciously provided by R. D. Suttkus. Transverse scales were counted from the dorsal midline at the origin of the soft dorsal fin to the base of the anal fin. Gill rakers, counted on the right side, include both dorsal and ventral rudiments. Dorsal blotches were counted on the left side of the midline, but blotches divided on one side and joined on the other are rare; the dark mark occasionally present on dorsal procurrent caudal fin rays was not counted. The basicaudal spot and surrounding dark area was counted as a lateral blotch, but if a dark mark occurred immediately anterior and dorsal to the most anterior obvious lateral blotch it was excluded. Nonparenthetical count ranges represent 90% or more of the frequency distributions. Measurements were made with a needle-point divider and distances, estimated to the nearest 0.1 mm, were read from a millimeter rule. Head length was measured to the tip of the opercular spine. Trans-pelvic width was measured between the outer bases of the pelvic spines.

Etheostoma flavum, new species

Saffron Darter

Plate 1

Etheostoma (Ulocentra) sp.—Clay, 1975:324–325 (sympatric with *E. atripinne* in lower Cumberland River drainage); Jenkins, 1976 (undescribed species, distribution).

Etheostoma sp.—Burr, 1980:78 (golden snubnose darter, Kentucky distribution); Kuehne and Barbour, 1983:96, pl. 12 (“golden snubnose darter,” characterized, range map).

Etheostoma flavigaster.—Gill, 1982:14 (color plate, *nomen nudum*).

Golden snubnose darter.—Page, 1983:pl. 15G, pl. 15H? (Pl. 15H in Page, labeled *E. simoterum*, is the same specimen as the female figured by Gill, 1982. Locality data for this fish, which appears to be *E. flavum*, differ between the two publications).

Saffron darter.—Burr and Warren, 1986:330 (distribution in Kentucky).

HOLOTYPE.—Adult male, UMMZ 213929, 49.0 mm standard length (SL), Elk Fork Creek at U.S. Hwy. 79, 9.5 air km NE of Guthrie, Todd Co., Ky., 21 June 1957, C. R. and F. A. Gilbert.

PARATOPOTYPES.—UMMZ 175042(25), collected with holotype.

OTHER PARATYPES.—**Cumberland River drainage, Kentucky.**

Trigg County: SIUC 11157(1), Crooked Cr. 9.3 km WNW Canton; SIUC 9620(1), Little R. 14.5 km SE Cadiz; SIUC 2236(5), Donaldson Cr. at Ky. Hwy. 164, 7.5 air km SE Canton; SIUC 10349(7), Donaldson Cr. at Skinner Rd., 9.3 km SE Canton. **Christian County:** SIUC 11158(1), Warrens Fk. at Little River Rd., 14.8 km E Hopkinsville; UT 91.1031(3), S Fk. Little R., Hopkinsville; UMMZ 169676(4), Little R. tribs. 3.2 km N Hopkinsville. **Logan County:** SIUC 11165(5), Little Whippoorwill Cr. at Berea Church Rd., 12.2 km SSE Russellville; SIUC 10588(7), KU 21184(4), and University of Oklahoma 43327(4), Whippoorwill Cr. at Ky. Hwy. 80, 11.3 km WSW of Russellville; UMMZ 160988(7), Dry Fk. Cr. at U.S. Hwy. 79, 15.8 km SW Russellville. **Todd County:** SIUC 6100(3), Elk Fk. Red R. at Mill Road, 3.2 km SSW Allensville; SIUC 10331(7), Elk Fk. Red R. at Ky. Hwy. 848 at Darnell, 7.6 km SSW Allensville; UMMZ 174926(6), E Br. W Fk. Red R. at U.S. Hwy. 41. **Simpson County:** SIUC 10524(3), Red R. at Ky. Hwy. 591, Prices Mill, 14.3 km WSW of Franklin.

Cumberland River drainage, Tennessee. Robertson County: UT 91.1318(8), Carr Cr. S Springfield; UT 91.2767(6), Sycamore Cr. at I-24, 17.2 km SSW Springfield. **Cheatham County:** UT 91.247(10), Turnbull Cr. 1.0 km W Kingston Springs; UMMZ 168419(17), Turnbull Cr. 0.8 km W Kingston Springs; UMMZ 174462(38) and UMMZ

177607(141), Turnbull Cr. trib. 2.4 km W Kingston Springs. **Dickson County:** UT 91.362(16), Turnbull Cr. at I-40, 16.7 km ESE Dickson; UMMZ 168291(18), Jones Cr. 6.8 km SE Charlotte at Tenn. Hwy. 47; UMMZ 120177(18) and UMMZ 113986(1), Jones Cr. and tribs.; UMMZ 175201(48), Yellow Cr. system N Ruskin, 16.1 km W Charlotte. **Williamson County:** UMMZ 175221(2), South Harpeth R. at Tenn. Hwy. 96, 18.9 km W Franklin.

Small eastern tributaries to lower Tennessee River, Tennessee.

Houston County: Illinois Natural History Survey 68219(23), Whiteoak Cr. at co. rd. 6261, 19.6 km NNW Waverly. **Humphreys County:** U.S. National Museum 270859(35), Whiteoak Cr. at co. rd. 6365, 16.1 km N Waverly; UAIC 7742.01(15), UT 91.2371(2), and TU 139774(15), Big Richland Cr. at road 5.8 km N Waverly.

Duck River system, Tennessee. Humphreys County: UT 91.743(19), Tumbling Cr. at Baptist Br., 18.0 km SE Waverly; UT 91.744(43), Hurricane Cr. 12.9 km ESE Waverly; UT 91.828(5), Duck R. at mouth Hurricane Creek, 10.6 km S Waverly; UT 91.2766(1), Duck River 0.8 km below Cold Branch Landing, 7.6 km SW Waverly; UT 91.1138(18) and UT 91.1366 (2, cleared and stained), Blue Cr. at co. rd. 6348, 5.3 km SSW Waverly; UMMZ 104936(3), Blue Cr. S Waverly. **Dickson County:** UMMZ 104892(1), Garner Cr., UMMZ 104870(1), E Fk. Piney R., and UMMZ 104884(3), Piney R., all Piney R. watershed SW Dickson. **Hickman County:** UT 91.357(83), Sugar Cr. at I-40, 22.7 km WNW Centerville; UT 91.758(23), Piney R. 0.5 km above mouth of Garner Cr., 18.3 km N Centerville; UMMZ 177629(69), Mill Cr. 22.5 km NE Centerville; KU 14400(5), Mill Cr. at Tenn. Hwy. 100, 16.3 km NNE Centerville; UT 91.767(53), Beaverdam Cr. 1.6 km above mouth of Joe Branch, 8.2 km WSW Centerville; UMMZ 105283(3), Beaverdam Cr. W Centerville; UT 91.1630(23) and UT 91.2581(4), Beaverdam Cr. at Tenn. Hwy. 50, 14.2 km W Centerville; UT 91.1291(14), Lick Cr. 1.6 km NW Primm Spring, 18.8 km ENE Centerville; UMMZ 104755(4), Locust Fk. of Lick Cr. ENE Centerville; UMMZ 105021(2), Defeated Cr., Centerville; UMMZ 105089(1), Bluebuck Cr. SE Centerville; UMMZ 105052(10), Swan Cr. SE Centerville; UMMZ 104973(3), Hassel Cr. E Centerville; UMMZ 104911(1), Haley Cr. E Centerville; UMMZ 104828(1), Big Spring Cr. N Centerville. **Williamson County:** UMMZ 104786(1), Lick Cr. SW Franklin; UMMZ 104777(3), Shoal Br. SW Franklin; UMMZ 104767(4), Younger Cr. SW Franklin; UMMZ 121379(2), Flat Cr. SSE Franklin; UMMZ 121545(5), Rutherford Cr. S Franklin. **Maury County:** UT 91.740(40), Fountain Cr. at mouth of Brush Cr., 15.0 km SE Columbia; UMMZ 121506(1), Brush Cr. SE Columbia; UT

91.763(53), Fountain Cr. at co. rd. 6353, Scribner's Mill, 14.5 km SE Columbia; University of Florida 42177(11), Academy of Natural Sciences Philadelphia 153835(11), UT 91.2438(13), Royal Ontario Museum 46459(3), and American Museum of Natural History 55781(10), Fountain Cr. at Tenn. Hwy. 50, 9.3 km SE Columbia; UT 91.759(47), Rutherford Cr. 1.3 km below Double Branch, 8.2 km NNE Columbia; KU 20930(9), Bear Cr. at Tenn. Hwy. 99, 4.0 km NE Columbia; UMMZ 96385(30), UMMZ 96386(1), UMMZ 104741(12), and UMMZ 104733(6), Little Bigby Cr. SSW Columbia; UMMZ 96398(2) and UT 91.735(23), Big Bigby Cr. SW Columbia; UMMZ 116005(1) and UMMZ 116019(1), Duck R. above and below dam at Kettle Mills; UMMZ 121508(3), Silver Cr. SE Columbia; UMMZ 121560(9), W Fk. Aenon Cr., UMMZ 121592(3), Carters Cr., UMMZ 121601(1), Crooked Cr., and UMMZ 104686(3), all Rutherford Cr. tribs. N Columbia; UMMZ 121578(1) and UMMZ 121583(1), McCutcheon Cr. and trib. 17.4 km NNE Columbia; UMMZ 104696(2), Knob Cr., NW Columbia; UMMZ 104718(1), Romantown Br. 14.8 km NNW Columbia; UMMZ 104726(2), Lytle Cr., Columbia. **Marshall County:** UT 91.1295(19), UMMZ 121443(6), Cornell University 70728(4), Los Angeles County Museum 43799-1(4), California Academy of Sciences 56329(3), and NLU 56292(3), Big Rock Cr. SSW Lewisburg; KU 14192(6), Mud Cr., E Rock Cr. trib. S Farmington, 9.7 km ENE Lewisburg; UMMZ 121388(1), Spring Cr., NNE Lewisburg; UMMZ 121478(6), Bear Cr., UMMZ 121455(1), E Fk. Globe Cr., and UMMZ 121465(3), Globe Cr., all Fountain Cr. tribs. W Lewisburg. **Bedford County:** UT 91.754(13), North Fk. Cr. 15.4 km NW Shelbyville; UMMZ 121359(1), Alexander Cr., North Fk. Cr. trib.; UT 91.775(21), Duck R. at Shelbyville; UT 91.2819(31) and UMMZ 121163(7), Norman Br. 3.8 km ESE Shelbyville; UMMZ 121155(1), Carr Cr., Norman Br. trib.; UMMZ 121196(22), Noah Fk., UMMZ 121236(2), Bradford Cr., UMMZ 121245(17), Wartrace Cr., UMMZ 121199(2), Sadie Br., UMMZ 121208(1), Puncheon Camp Cr., and UMMZ 121228(1), Panel Br., all Garrison Fk. Cr. tribs. NE Shelbyville; UMMZ 121096(34), Flat Br., UMMZ 121076(14), Possum Cr., UMMZ 121036(67), Coleman Cr., UMMZ 121051(2), Bobo Br., UMMZ 121106(4), Crooked Run, and UMMZ 121065(3), Goose Cr., all Flat Cr. tribs. SSE Shelbyville; UMMZ 121130(5), Thompson Cr., UMMZ 121146(4), Anthony Br., and UMMZ 121140(2), Anderton Br., all Thompson Cr. watershed SE Shelbyville; UMMZ 121285(1), Hurricane Cr. NW Shelbyville; UMMZ 121314(2), Ashland Br. of Sugar Cr. SSW Shelbyville; UMMZ 121331(1), Sinking Cr. W Shelbyville; UMMZ 121394(3), Wilson Cr. NW Shelbyville; UMMZ 121174(3), Cascade Br. of Doddy Cr. E

Shelbyville; UMMZ 121150(1), Shipman Cr. E Shelbyville. **Coffee County:** UT 91.227(31), Garrison Fk. Cr. at U.S. Hwy. 41, Beech Grove; AUM 25550(3), Ohio State University 60341(3), Oregon State University 11036(3), and Oklahoma State University 11993(3), Garrison Fk. Cr. at co. rd. 4401, 5.8 km NNE Beech Grove; UT 91.2737(4), Riley Cr. trib. along co. rd. 4442, 0.8 km above Normandy Reservoir, 10.3 km W Manchester; TU 30312(66), Duck R. at U.S. Hwy. 41 (now Chumbley Lake), 2.1 km NW Manchester; UT 91.2811(41), Duck R. 5.8 km N Manchester; UT 91.2806(16), Duck R. 8.5 km N Manchester; UMMZ 120866(11), Spring Br. and Newman Br., Carroll Cr. tribs. 11.2 km SW Manchester.

Buffalo River system, Tennessee. Perry County: UT 91.617(39) and UMMZ 105270(1), Cane Cr. NE Linden; KU 20853(1) and UMMZ 105248(2), Coon Cr. E Linden; UMMZ 105257(9), Brush Cr. NE Linden. **Wayne County:** UT 91.615(99), UMMZ 105226(9), and UMMZ 113946(1), Green R. N Waynesboro; UT 91.871(12) and UT 91.861(17), Moccasin Cr. N Waynesboro; SIUC 3601(3), Fortyeight Cr. at U.S. Hwy. 64, 9.7 km ENE Waynesboro; SIUC 6120(5), Buffalo R. at Tenn. Hwy. 13, 15.3 km N Waynesboro. **Lewis County:** UT 91.490(10) and SIUC 6464(4), Buffalo R. at mouth of Grinders Cr., 9.0 km S of Hohenwald; SIUC 3411(3), Trace Cr. at mouth, 13.5 km SSW Hohenwald; UMMZ 105193(3), Grinders Cr., UMMZ 105209(5), Brush Cr., and UMMZ 105216(11), Rockhouse Cr., all S Hohenwald. **Lawrence County:** UT 91.332(59), S Fk. Buffalo R. at U.S. Hwy. 43, 15.3 km NNE Lawrenceburg; UMMZ 105139(23), Saw Cr., and UMMZ 105124(1), Buffalo R., both NNW Lawrenceburg; UMMZ 105151(21), Chief Cr. NW Lawrenceburg.

ADDITIONAL MATERIAL EXAMINED BUT NOT DESIGNATED AS TYPES.—**Duck River system, Tennessee. Coffee County:** UT 91.2352(106), UT 91.2452(26), and UT 91.2786(32), Bashaw Cr. at first bridge above mouth, 4.2 km WNW Manchester; UT 91.2820(8), Hale Branch below lowest bridge, 4.9 km SW Manchester (these all show evidence of introgressive hybridization with *E. duryi*).

Indian Creek system, Tennessee. (All of the following show evidence of introgressive hybridization with *E. duryi*.) **Hardin County:** NLU 56477(21) and UT 91.2803(2), Indian Cr. at U.S. Hwy. 64, 21.0 km ENE Savannah; UT 91.2807(13), Smith Fk. at U.S. Hwy. 64, 16.1 km ENE Savannah. **Wayne County:** TVA 2.73(12), Waterfall Cr. 12.1 km WNW Collinwood; UT 91.2798(26), Indian Creek near co. rd. 6228, 0.8 km above Moser Branch, 11.3 km WNW Collinwood.

DIAGNOSIS.—*Etheostoma flavum* is a member of the subgenus *Ulocentra* as defined by Bouchard (1977) and Bailey and Etnier (1988)

and is aligned with the *E. duryi* species group (Bailey and Etnier, 1988). It differs from members of the *E. simoterum* species group in consistently lacking a premaxillary frenum and in often having vomerine teeth. Differs further from *simoterum* in having a more produced snout, in having the basicaudal dark spot single and not separated into dorsal and ventral segments by a pale area, and as indicated in Table 1. Differs from *E. coosae*, *E. duryi*, *E. etnieri*, *E. pyrrhogaster*, *E. zonistium*, and several undescribed *Ulocentra* from lower Mississippi and Gulf Coast drainages (the *E. duryi* species group) in virtually lacking the red coloration (except in membranes of soft dorsal fin) variously developed on fins and bodies in males (and often females) of these species. Differs further from *E. duryi* in usually having 25 or fewer dark marks (lateral blotches, both sides, plus dorsal blotches) versus 26 or more in *duryi* (Tables 2 and 3). Adult male (and some female) *flavum* have yellow to orange lips in life (gray or green, never yellow or orange, in *duryi*), usually lack a red ocellus in first membrane of spinous dorsal fin (usually present in *duryi*, Table 4), have yellow lower side (orange to red upper and lower side in *duryi*), and lack orange to red basicaudal spots (present in male, female, and juvenile *duryi*). Additional differences between these species appear in Table 2.

DESCRIPTION.—*Etheostoma flavum* reaches a maximum of 52 mm SL (females) to 60 mm SL (males). Sexual dimorphism and apparent sexual maturity occur after one year's growth at about 28 mm SL in both sexes.

Frequency distributions of scale and fin ray counts appear in Tables 4–6. Lateral line complete with (42)45–54(59) scales. Transverse scales 11(2 specimens), 12(29), 13(170), 14(111), 15(21), or 16(2). Caudal peduncle scale rows 15(6), 16(27), 17(146), 18(60), 19(86), 20(9), or 22(1). Dorsal fin with (9)10–12 spines and (9)10–12(13) soft rays. Anal fin with 2 spines and 6–8(9), modally 7, soft rays. Pectoral fin rays (13)14–15(16). Principal caudal fin rays 16–17(18), modally 17. Branchiostegal rays 5–5 (5–6 or 6–5 in 3 of 67 specimens); gill membranes broadly connected. Vertebrae 37(2), 38(56), 39(97), or 40(11). Vomerine tooth or teeth present in 19 of 65 specimens. Cephalic sensory canals complete with 14(3), 15(4), 16(53), or 17(16) infraorbital canal pores and 16(2), 17(4), 18(111), or 19(2) preoperculomandibular canal pores (sum of counts from left and right sides). Lateral canal with five pores, supratemporal canal with three pores, coronal pore single. Gill rakers 8(2), 9(24), 10(12), or 11(2), with length of longest rakers 1–2.5 times their basal width. Belly, opercle, cheek, and prepectoral area covered with exposed scales. Breast completely naked to naked

anteriad and covered with embedded to weakly exposed scales on posterior half.

Proportional measurements appear in Tables 7–8. *Etheostoma duryi* data are from nuptial specimens (17 March, 3 April); *E. flavum* measurements are from March through October specimens. The wide range of dates for *E. flavum* apparently had little effect on ranges of values or on means of measurements exhibiting sexual dimorphism. In both species, males have larger fins (except the caudal) than females, while females have greater body width.

Colors of live and freshly preserved nuptial specimens, collected in late March, are described from Indian Creek and Cumberland, Duck, and Buffalo river specimens. Nuptial males with lower side and ventral surface uniformly yellow to orange-yellow below lateral band and extending forward onto lower parts of operculum, cheek, and suborbital area. Lips and basal half of anal fin often with pigment intensifying to orange; branchiostegal membranes and gular area often paler yellow than surrounding area. Lateral stripe inconspicuous to nearly as dark as the 8 (7–9) black lateral blotches, and extending about one scale row above lateral line. Lateral blotches extend 2–3 scale rows below lateral line antieriad and 1–2 scale rows below on caudal peduncle. Lateral blotches 3 or 4 through 8 (at caudal base) extend dorsad to join dorsal blotches. Lateral blotch 3 often continuous with dorsal blotch 3 (under middle of spinous dorsal fin), but these dark areas frequently separate. Lateral blotch 4 consistently joined with dorsal blotch 4 (posterior end of spinous dorsal fin). Lateral blotch 5 extends up and antieriad to contact dorsal blotch 5 (anterior base of soft dorsal fin), but lateral blotch 6 typically extends up and back to contact dorsal blotch 7 (posterior end of soft dorsal fin), leaving dorsal blotch 6 (middle of soft dorsal) isolated from lateral blotches. Variations on this scheme are frequent, but the obliquely forward extensions of anterior lateral blotches contrast quite consistently with the obliquely posteriad extensions of lateral blotches 6 (or 5) through 7. Upper side with gray-brown background, becoming more yellowish on caudal peduncle. Dorsal blotches 8 (7–9). First and second blotches immediately posteriad to occiput, and centered under first dorsal spine, respectively. Dorsal blotch 8 immediately anterior to dorsal insertion of caudal fin. Suborbital bar faint to moderately developed, nearly vertical. Dorsal surface of head, snout, and upper halves of operculum and cheek dark gray. Iris dark brown above with gold halo around pupil; ventral half of iris paler brown, often with a gold to silver band from pupil to suborbital bar. Spinous dorsal fin with distinctive narrow marginal band buff to brownish orange on

TABLE 1

COMPARISON OF *Etheostoma simoterum* AND *E. flavum*, COMMONLY SYMPATRIC SPECIES OF SUBGENUS *Ulocentra* FROM INDIAN CREEK AND DUCK RIVER (TENNESSEE RIVER DRAINAGE) AND LOWER CUMBERLAND RIVER DRAINAGE

Character	<i>E. simoterum</i>	<i>E. flavum</i>
Premaxillary groove	shallow, premaxillae scarcely protractile	deep, premaxillae readily protractile
First dorsal blotch	subquadrate, separate from first lateral blotch	saddle-like, fused with first lateral blotch
Dorsal blotches	usually 9, first dorsal fin contacts 4 blotches	usually 8, first dorsal fin contacts 3 blotches
Lateral blotches	well separated from dorsal blotches, discrete	middle and posterior blotches in contact with dorsal blotches, often enlarged
Red and red-brown on body (adult male)	numerous spots on upper side, a broad stripe on ventrolateral area	none
Lower side (female)	with greenish bronze or blackish marks	immaculate
First dorsal fin (adult male)	series of red spots, one per membrane, or (Indian Cr.) posterior membranes brick red	no red except occasionally on first membrane (see Table 4)
Basicaudal dark pigment	separated into dorsal and ventral spots by pale area	single median dark spot
Snout shape	very blunt, snout overhangs upper lip	more produced, snout extends little if any forward of upper lip

margin and with dark brown lower border. Base of fin with black band occupying basal 1/4–1/2 of first membrane, narrowing posteriad and disappearing near or slightly posterior to middle of fin base. Red ocellus in first dorsal membrane usually absent, but occasionally well developed (Table 4). Remainder of fin with brown spines and yellow to brown membranes; membranes of uniform color or palest (yellow) adjacent to spines, or with darker brown markings between spines in form of vertical streaks to oblique dashes, but never forming horizontal rows of spots or vermiculations. Soft dorsal fin with gray to yellowish rays speckled with dark chromatophores; membranes brick red, with red fading to yellow or orange near margin and often

TABLE 2
COMPARISON OF *Etheostoma duryi* AND *E. flavum* FROM MIDDLE AND LOWER TENNESSEE
RIVER DRAINAGE

Character	<i>E. duryi</i>	<i>E. flavum</i>
Total dorsal and lateral blotches (see Table 3)	modally 26	modally 24, rarely 26 or more
Soft dorsal fin rays (mode) + mean (see Table 4)	(12), > 11.5	(11), < 11.5
Percent of adults with red ocellus in first spinous dorsal fin membrane (see Table 4)	50% or more	25% or fewer
Color of lips, adult male	green or gray	yellow to orange
Color of upper and lower side, adult male	orange to red lower and often upper side	yellow lower side, olive upper side
Color of basicaudal area, adult male	pair of orange to red spots	pair of yellow spots
Color of procurrent caudal fin rays	trace at most of green or blue	extensive areas of green to blue
Membranes of spinous dorsal fin, adult male	3–6 rows of brick red vermiculations or blotches	uniformly brown to brown with darker reticulations or vertical streaks
Marginal band of spinous dorsal fin, adult male	narrow and black, often not continuous	continuous, darkest at base, brown to orange near margin of fin
Vertebrae	37(10), 38(74), 39(21), or 41(1)	37(2), 38(56), 39(97), or 40(11)
Length of anal fin as thousandths of SL—males, females (see Tables 7–8)	244, 215	266, 236

weakly developed or absent on anterior 1–3 membranes. Caudal fin with bright green to blue on upper and lower procurrent rays and adjacent 1–2 principal rays and associated membranes. Middle membranes pale at base, flushed with orange or yellow near middle of fin, and densely speckled with dark chromatophores near posterior mar-

TABLE 3
TOTAL MARK COUNTS (DORSAL BLOTCHES PLUS LATERAL BLOTCHES, BOTH SIDES) FOR *Etheostoma flavum** AND *E. duryi*

	21	22	23	24	25	26	27	28	29	30+	Percent with 26 or more marks
<i>Etheostoma flavum</i>											
Cumberland R. dr.		1	7	65	8	4					4.7
lower Tennessee R. dr.			7	51	22	3	1				4.8
Buffalo R. system			8	122	29	3	5	1			5.3
lower Duck R. system	1	1	15	159	41	9	1				4.4
middle Duck R. system		8	37	219	39	10	1				3.5
Norman Br. of Duck R., Bedford Co.			2	18	9	2					6.5
upper Duck R. system, Coffee Co.											
upper Duck R.	2	5	15	89	14	3	2				3.8
Carroll Creek		1	3	6	1						0.0
<i>E. flavum</i> (with evidence of introgression with <i>E. duryi</i>)											
Bashaw Creek, Coffee Co.	1	3	9	82	46	17	8	1	1		16.0
Hale Branch, Coffee Co.			1	1	3	1	1	-	1		37.5
Indian Creek, Wayne & Hardin cos.		2	6	53	53	18	7	3			19.7
<i>Etheostoma duryi</i>											
upper Duck River system, Coffee Co.											
Crumpton Creek	1	2	5	29	52	61	57	39	26	3	67.6
Little Duck R.			6	47	49	42	31	8	6	4	47.2
Duck R. below Bashaw Creek			2	8	13	10	9	5	-	2	53.1
W. tribs., lower Tennessee R.				3	3	9	10	6	3		82.4
Blue Creek, Humphreys Co.				3	8	4	2	3			45.0
Hardin Creek, Hardin Co.				2	2	6	6	8	3	4	87.1
lower Indian Creek, Hardin Co.				4	3	9	5	4	3	1	75.9
Horse Creek, Hardin Co.		1	1	2	8	6	9	2	4	6	69.2
Bear Creek system, Alabama		1	4	9	11	19	17	8	3		65.3
Shoal Creek system		1	6	21	35	32	23	7	5		55.8
Elk R. system		1	2	15	20	22	18	3	8	7	60.4
Chattanooga area			1	3	8	18	36	21	6	5	87.8
Clinch R. system				9	7	10	6	4			55.6

*Count for holotype in boldface.

TABLE 4
 NUMBER AND PERCENT OF MALES AND FEMALES WITH OCELLUS IN FIRST DORSAL FIN MEMBRANE, AND NUMBERS OF SOFT DORSAL FIN RAYS FOR
*Etheostoma flavum** and *E. duryi*

	Number and percent with ocellus		Soft dorsal fin rays							N	\bar{X}	
	males	females	9	10	11	12	13	14				
<i>Etheostoma flavum</i>												
Cumberland R. dr.	3/27	11.1	1/25	4.0	1	3	24	11	1	1	40	11.20
lower Tennessee R. dr.	10/24	41.7	4/30	13.3	3	3	25	23	3	3	54	11.48
Buffalo R. system	1/51	2.0	1/49	2.0	6	31	14	14			51	11.16
lower Duck R. system	10/66	15.2	5/62	8.1	4	35	17	2	2		58	11.29
middle Duck R. system	6/39	15.4	2/17	11.8	15	47	8	8			70	10.90
Norman Br. of Duck R., Bedford Co.	0/14	0.0	0/18	0.0	1	23	4	3			31	11.29
upper Duck R. system, Coffee Co.	13/48	27.1	7/75	9.3	1	20	78	22	2		123	11.03
Carroll Creek	2/4	50.0	1/7	14.3	2	8	1				11	10.91
<i>E. flavum</i> (with evidence of introgression with <i>E. duryi</i>)												
Hale Branch	0/3	0.0	2/5	40.0		5	3	3			8	11.38
Bashaw Creek	10/53	18.9	12/60	20.0	14	58	28	2	2		102	11.18
Indian Creek, Wayne & Hardin cos.	27/53	50.9	11/51	21.6	1	20	77	41	2		141	11.16

TABLE 4, continued

	Number and percent with ocellus				Soft dorsal fin rays						N	\bar{X}
	males		females		9	10	11	12	13	14		
<i>Etheostoma duryi</i>												
upper Duck R. system, Coffee Co.												
Crumpton Creek	64/113	56.6	64/98	65.3		1	44	82	16		143	11.79
Little Duck R.	25/84	29.8	53/98	54.1		2	73	97	24	1	196	11.75
Duck R. below Bashaw Creek	16/37	43.2	4/12	33.3			17	27	6		50	11.78
W. tribs., lower Tennessee R.	15/18	83.3	4/13	30.8			10	26	6		42	11.90
Blue Creek, Humphreys Co.	4/4	100.0	4/17	23.5			2	18	1		21	11.95
Hardin Creek, Wayne Co.	7/8	87.5	7/15	46.7			5	21	5		31	12.00
lower Indian Creek, Hardin Co.	9/10	90.0	13/19	68.4			7	18	3	2	30	12.00
Horse Creek, Hardin Co.	5/5	100.0	7/10	70.0			11	20	3		34	11.76
Bear Creek system, Alabama	15/20	75.0	22/38	57.9		2	37	30	2	1	72	11.49
Shoal Creek system	22/24	91.7	16/35	45.7			29	28	2		59	11.54
Elk R. system	30/40	75.0	15/23	65.2		1	19	42	5		67	11.76
Chattanooga area	20/23	87.0	16/47	34.0		1	36	25	-	2	64	11.44
Clinch R. system	13/14	92.9	17/23	73.9		1	20	15	3		39	11.51

*Count for holotype in boldface.

TABLE 5
LATERAL-LINE SCALE COUNTS FOR *Etheostoma flavum** AND *E. duryi*

	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	N	\bar{X}	
<i>Etheostoma flavum</i>																								
Cumberland R. dr.				1	3	3	10	5	13	15	13	12	7	1	2	1							86	47.9
lower Tennessee R. dr.							1	2	5	2	9	8	5	7	4	5	-	1					49	50.3
Buffalo R. system									8	5	15	10	13	9	11	5	7	4	-	-	1		87	51.8
lower & middle																								
Duck R.					1	-	1	4	5	10	14	17	12	8	6	5	1						84	49.9
upper Duck R.,																								
Coffee Co.				1	-	2	2	3	5	17	16	14	9	2	4								75	48.9
Indian Creek				1	2	3	4	8	4	7	11	4	2	3	1	-	1	1					52	47.9
<i>Etheostoma duryi</i>																								
upper Duck R.,																								
Coffee Co.					3	4	5	6	10	12	10	10	7	4	5	-	3						79	48.6
W. tribs., Tennessee R.				1	-	-	5	4	8	12	14	5	4	2	1	1	2	1	1				61	48.8
Blue Creek							1	1	8	2	2	3	3	-	-	-	1						21	48.5
Hardin Creek									5	1	3	6	6	5	2	1	-	1					30	50.4
Indian Creek				1	1	2	2	6	7	3	5	2											29	46.8
Horse Creek	1	-	2	6	8	3	6	6	2	5													39	44.3
Bear Creek, Alabama				1	1	3	2	4	4	3	4	4	-	1									27	47.1
Shoal Creek system		1	-	1	3	6	8	11	18	6	5	4	2	2	1								68	48.0
Elk R. system		3	3	2	1	4	8	10	12	11	12	11	4	2	2								85	47.2
Chattanooga area			4	4	4	7	7	14	10	8	9	6	1										74	48.4
Clinch R. system				3	4	3	4	5	6	4	5	2	2										38	46.2

*Count for holotype in boldface.

TABLE 6
DORSAL SPINES, AND ANAL, PECTORAL, AND PRINCIPAL CAUDAL FIN RAY COUNTS FOR *Etheostoma flavum** AND *E. duryi*

	Dorsal spines					Anal soft rays					Pectoral rays					Principal caudal rays			
	9	10	11	12	13	5	6	7	8	9	12	13	14	15	16	15	16	17	18
<i>Etheostoma flavum</i>																			
Cumberland R. dr.		15	70	26			10	70	31			7	79	53	2		6	38	1
lower Tennessee R. dr.	1	7	16	2			1	18	6	1		2	18	6			7	24	2
Buffalo R. system	1	13	29	3			4	31	11			2	25	19			9	31	1
lower & middle Duck R.		34	99	19			28	107	19			7	112	62	1		4	26	4
upper Duck R., Coffee Co.		12	32	4			10	31	7			6	31	10			2	39	2
Indian Creek		1	33	2				20	17			2	26	8	1		8	28	1
<i>Etheostoma duryi</i>																			
upper Duck R., Coffee Co.		16	13	15		2	7	29	6			2	31	10	1		1	21	11
W. tribs., Tennessee R.		6	24	12			6	31	5		1	13	23	3		5	12	20	
Blue Creek		3	13	4	1		3	16	2			5	14	2		3	4	9	
Hardin Creek		2	14	6			1	15	6			1	14	7			3	19	
Indian Creek	1	1	4	1			3	2	1	1		2	5					4	1
Horse Creek		7	22	5		1	12	26	2		1	16	17				2	15	
Bear Creek, Alabama		6	19	2	1		7	19	2				19	9			2	22	3
Shoal Creek system		2	30	25	1		2	26	5			3	23	7		3	13	22	2
Elk R. system	1	11	22	2			10	23	4			3	24	3			4	20	1
Chattanooga area		8	27	4			12	29	4			9	29	2		2	13	19	2
Clinch R. system		5	25	9			9	27	2	1		5	29	5		1	11	23	2

*Counts for holotype in boldface.

TABLE 7
MEASUREMENTS IN THOUSANDTHS OF STANDARD LENGTH FOR *Etheostoma flavum* AND *E. duryi* MALES*

	<i>Etheostoma flavum</i>				<i>Etheostoma duryi</i>	
	Cumberland River \bar{X}	range	Tennessee River \bar{X}	range	\bar{X}	range
Standard length (mm)	50.0	45.4-57.0	47.5	45.3-54.7	49.4	47.5-51.0
Head length	233	221-239	232	221-246	234	229-239
Body depth at dorsal origin	229	207-249	226	200-254	246	237-260
Snout length	73	64-79	73	64-78	70	63-77
Orbit length	65	60-69	69	67-73	68	64-71
Spinous dorsal fin length	340	326-372	330	296-358	335	302-362
Longest dorsal spine	160	125-185	164	144-187	154	135-173
Soft dorsal fin length	314	300-321	322	300-342	312	286-329
Longest dorsal soft ray	184	162-197	194	179-214	191	176-210
Caudal peduncle length	307	293-326	311	294-325	312	293-331
Caudal peduncle depth	107	99-113	104	94-111	110	106-118
Anal fin length	269	250-289	263	253-278	244	229-270
First anal spine length	89	74-110	85	76-95	89	75-114
Longest anal soft ray	162	145-180	162	146-177	151	141-170
Caudal fin length	220	199-229	223	204-232	218	178-239
Pectoral fin length	276	259-293	272	247-295	264	243-290
Pelvic fin length	237	224-249	229	200-238	235	214-253
Trans-pelvic width	81	75-90	78	71-82	84	80-100
Maximum body width	136	116-154	137	120-147	134	124-163
Interorbital width	45	40-50	44	38-48	45	39-54

*Means and ranges represent values for ten adults.

TABLE 8
MEASUREMENTS IN THOUSANDTHS OF STANDARD LENGTH FOR *Etheostoma flavum* and *E. duryi* FEMALES*

	<i>Etheostoma flavum</i>				<i>Etheostoma duryi</i>	
	Cumberland River \bar{X}	range	Tennessee River \bar{X}	range	\bar{X}	range
Standard length (mm)	42.7	37.0–46.0	43.4	38.6–49.0	40.6	39.0–42.7
Head length	228	218–242	228	216–241	237	228–247
Body depth at dorsal origin	212	195–229	240	203–276	238	214–266
Snout length	67	62–72	70	66–75	68	63–74
Orbit length	69	67–76	71	65–75	74	71–79
Spinous dorsal fin length	292	277–329	303	266–320	295	271–327
Longest dorsal spine	133	119–155	132	120–145	128	103–148
Soft dorsal fin length	266	252–279	260	241–285	259	238–304
Longest dorsal soft ray	162	152–168	163	147–180	153	138–169
Caudal peduncle length	310	289–328	310	285–337	313	285–351
Caudal peduncle depth	100	94–109	97	89–106	97	94–103
Anal fin length	236	219–252	236	220–255	215	195–234
First anal spine length	85	72–100	87	80–98	90	62–112
Longest anal ray	151	144–161	157	139–175	145	127–161
Caudal fin length	215	202–236	222	192–236	211	195–226
Pectoral fin length	260	230–293	264	239–292	261	232–313
Pelvic fin length	221	210–237	224	204–245	221	190–256
Trans-pelvic width	79	74–81	77	73–80	79	72–89
Maximum body width	146	140–157	181	131–224	159	139–199
Interorbital width	41	35–45	43	37–47	45	42–48

*Means and ranges represent values for ten adults.

gin. Middle caudal rays uniformly dark brown to having pale joint areas basad; distal part of rays (slightly beyond first branch) often immaculate. Anal fin with basal third to half yellow to orange on rays and membranes, distal part dark gray with green or blue iridescence. Pelvic fin also dark gray with green or blue iridescence. Pectoral fin with membranes clear and immaculate to moderately sprinkled with dark chromatophores; rays profusely covered with dark chromatophores over a pale yellow background.

In females, lower side and ventral surface immaculate white or nearly so, with a wash of pale yellow near the lateral midline and in the prepectoral area. Side of head white, dark suborbital bar present. Orange pigment often present on middle of upper lip, occasionally on lower lip as well. Anterior surface of elongate urogenital tube yellow. The pattern of lateral and dorsal blotches is as described for males. Upper side with olivaceous background. Spinous dorsal fin with three rows of vertically elongate dark marks on posterior margins of otherwise clear spines. Membranes clear or with scattered melanophores; dark basal band and narrow dark marginal band often present. The marginal band may show traces of yellow or orange. The basal band often consists of a row of rounded dark spots. Red ocellus occasionally present in anterior membrane (Table 4). Soft dorsal fin with pale yellow rays interrupted by 3-4 rows of dark brown dashes. Last 3-4 membranes yellow to brick red in larger females, otherwise clear. Caudal fin with clear membranes; rays clear to pale yellow alternating with dark markings that form 3-4 irregular vertical bands. Green to pale blue often present on upper and lower procurrent caudal rays, 1-2 adjacent principal rays, and associated membranes. Anal, pectoral, and pelvic fins with clear membranes and clear to pale yellow rays; pectoral rays often irregularly edged with brown streaks.

In preservative, the iridescent blue and green colors fade very quickly; the yellows, oranges, and brick reds are more persistent. The presence of a red ocellus in the first dorsal fin membrane is detectable in faded specimens as an opaque, cream colored area surrounded by dark pigment.

DISTRIBUTION.—*Etheostoma flavum* is confined to the lower Cumberland and lower Tennessee river drainages (Fig. 1), where it is often one of the most abundant darters in second to fourth order streams. In the Cumberland drainage it occurs from near the mouth upstream through the Harpeth River and Sycamore Creek, which enter on opposite sides of the Cumberland River in Cheatham County, Tennessee. It may occur slightly farther upstream in the

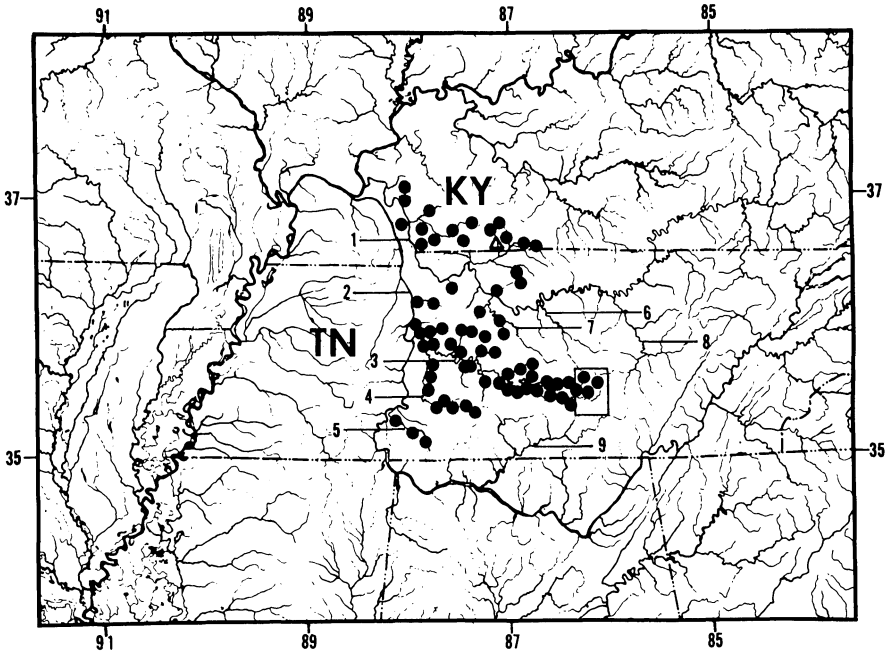


FIG. 1. Distribution of *Etheostoma flavum*. Type locality indicated by open triangle. Enlargement of inset, upper Duck River system, appears in Fig. 2. Stream identifications: 1, Cumberland River; 2, Tennessee River; 3, Duck River; 4, Buffalo River; 5, Indian Creek; 6, Stones River; 7, Harpeth River; 8, Caney Fork; 9, Elk River.

Cumberland, as the smaller streams in this area are poorly collected. It has not been taken from the well collected Stones River system, whose mouth is about 87 river km above the mouths of Harpeth River and Sycamore Creek. In the Tennessee drainage downstream from the mouth of Duck River, it occurs in major eastern tributaries (Richland and Whiteoak creeks), but is absent from all western tributaries to the lower Tennessee (*E. duryi* occupies Highland Rim areas and *E. zonistium* occurs on the Coastal Plain in these streams). *E. flavum* occurs to the exclusion of *E. duryi* throughout the lower and middle part of the Duck River system, and throughout the Buffalo River system, a major tributary to the Duck.

In the upper Duck River system (Fig. 2) what appear to be "pure" *flavum* populations persist in the upper Duck River proper above Manchester, Coffee County. This area has apparently escaped encroachment from *E. duryi* due to a series of high natural waterfalls

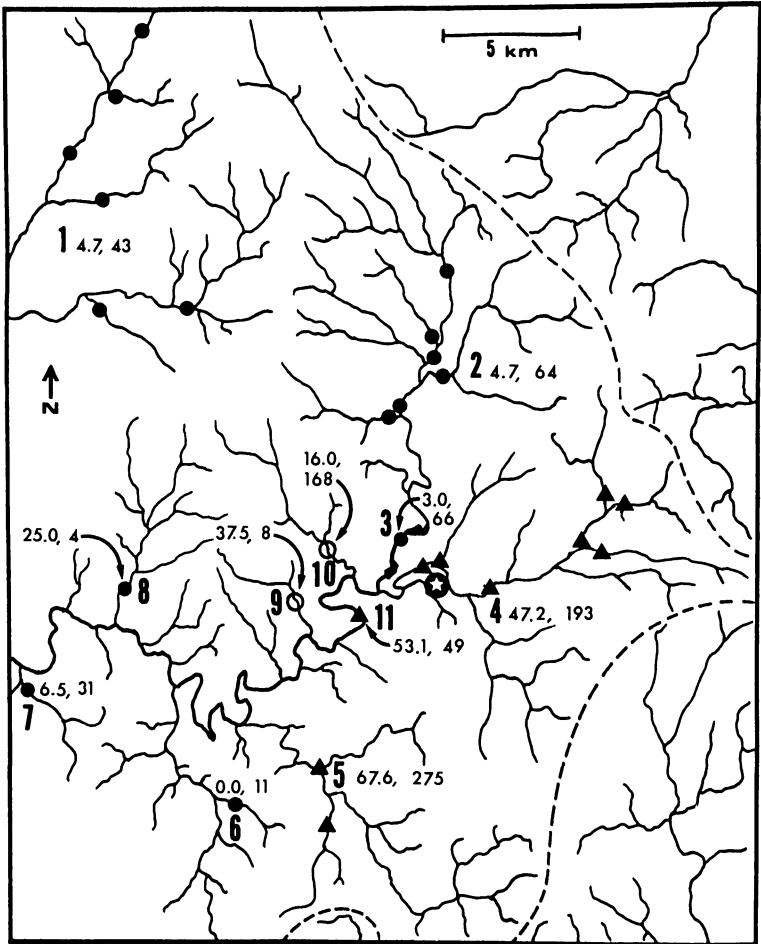


FIG. 2. Upper Duck River, Coffee County, Tennessee, distribution of *Etheostoma flavum* (solid circles), *E. duryi* (triangles), and *E. flavum* populations showing evidence of past introgression with *E. duryi* (open circles). Numbers associated with localities are percentages of specimens with 26 or more marks (e.g., right column of Table 3) followed by sample sizes. Number 1, Garrison Fork tributaries, included with middle Duck River system in Table 3; 2, upper Duck River; 3, area of barrier falls and Chumbley (south) and Morton lakes, included with upper Duck River in Table 3; 4, Little Duck River and Taylor Branch; 5, Crompton Creek; 6, Carroll Creek; 7, Norman Branch; 8, Riley Creek, included with middle Duck River in Table 3; 9, Hale Branch; 10, Bashaw Creek; 11, Duck River below Bashaw Creek. Undesignated northeastern and southeastern streams outside dashed line enter Caney Fork system of Cumberland drainage and Elk system of Tennessee drainage, respectively. Circled star at location of Manchester.

and two small impoundments (Morton Lake, completed in 1940; Chumbley Lake, completed about 1963) above the mouth of Little Duck River. Below these barriers, *E. flavum* morphs occur in northern tributaries to Duck River in Bashaw Creek and Hale Branch, but characters of these populations (Tables 3 and 4) suggest introgression with *E. duryi*. Northern tributaries to Duck River from Riley and Garrison Fork creeks (included with "middle Duck River" in Tables) have *flavum* populations showing little if any evidence of *duryi* influence. Headwaters of Normandy Reservoir (completed in 1976) presumably prevent or severely restrict further downstream movement of *E. duryi* at present. Southern tributaries to upper Duck River (Little Duck River and Taylor Branch, Crumpton Creek) contain *E. duryi* morphs inseparable from Elk River *duryi* in characters included in Tables 1 and 2, and share with Elk River *duryi* two aspects of nuptial male pigmentation (dark edgings on lateral scales, horizontal rows of brick red vermiculations in spinous dorsal fin) not seen elsewhere in *duryi*. The lack of morphological evidence of past introgression with *flavum* in these Little Duck River and Crumpton Creek *duryi* suggests that these systems were formerly Elk River tributaries that have been captured by the Duck. Low divides containing sinkholes and perched swamps and ponds, plus the presence of interdigitating streams with frequent right-angle bends in present Elk and Duck river tributaries on the Barrens Plateau just south of Manchester, are consistent with this hypothesis, as are the distributions of additional fish species. *Fundulus julisia* is known from the upper Elk and Little Duck river systems on the Barrens Plateau, but does not occur elsewhere in the upper Duck River system (Starnes and Etnier, 1986). *Etheostoma nigripinne*, widespread in the Elk River system, occurs in the Little Duck River system, but the closely related *E. crossopterum* occupies most of the remainder of the upper and middle Duck River system (Braasch and Mayden, 1985). Precise distribution of these two taxa in the upper Duck remains uncertain due to unavailability of nuptial males from many localities.

Southern tributaries to upper Duck River below Crumpton Creek include Carroll Creek and Norman Branch, both of which have their mouths impounded by Normandy Reservoir. From Carroll Creek we have seen only 11 specimens of *flavum* from a 1937 collection. These show no evidence of contact with *duryi*, suggesting that the Carroll Creek system has not been connected with upper Elk River. The many falls in the lower part of this system have apparently prevented upstream movement of *duryi* from Duck River. Norman Branch, sampled on 29 March 1985, contained large numbers of ap-

parently "pure" *flavum* along with a single adult male *E. duryi*. Duck River proper below the mouth of Little Duck River and above Normandy Reservoir contains *duryi* morphs differing little if any from those in Little Duck River and Crumpton Creek.

The only explanation for these distributions that is consistent with the presence of pure *flavum* populations in Duck River above barrier falls at Manchester and the shared pigmentation patterns of Elk River and upper Duck River *duryi* involves piracy of former Elk River tributaries by the Duck River system in the area now occupied by Little Duck River and Crumpton Creek.

Etheostoma flavum has apparently gained access to the headwaters of Indian Creek via headwater piracy from the Buffalo River system. This hypothesis explains the absence of *flavum* and presence of *duryi* in other eastern tributaries to the lower Tennessee River between the mouths of Indian Creek and Duck River, the evidence of *duryi* influence on Indian Creek *flavum* populations (Tables 3 and 4), and the persistence of *duryi* in at least one stream in the lower Indian Creek system (Alexander Branch). Tributaries to the Tennessee River upstream from Indian Creek contain *duryi*, but *flavum* is absent from this area.

Our data provide evidence of contamination of *flavum* populations by *duryi*, but no convincing evidence of introgressed *duryi* populations. Additional analysis of *duryi* populations in Duck River proper above Normandy Reservoir and Blue Creek (eastern tributary to Tennessee River just upstream from mouth of Duck River) might reveal past introgression with *flavum*.

In this apparent case of introgressive hybridization and competitive exclusion, it is interesting to note that *duryi* has been the "victor" in parts of the upper Duck River system while *flavum* assumes that role in Indian Creek. Regional physiography may be important in determining the outcome of these encounters. *Etheostoma flavum*, with its yellowish overall coloration, persists where substrates are dominated by yellow to orange gravels of Fort Payne Chert origin (Highland Rim), while the much more darkly pigmented *duryi* appears to have the advantage where substrates are of darker limestones and shales.

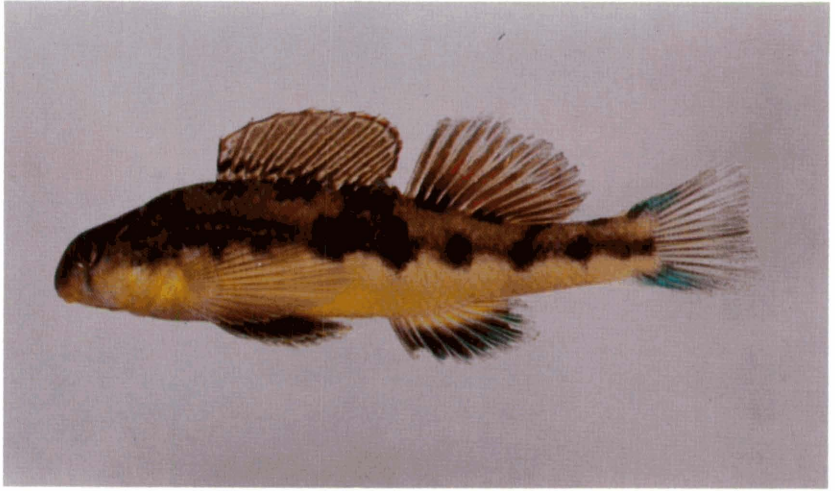
ETYMOLOGY.—The adjectival name is derived from the Latin *flavus*, golden-yellow or yellow, the predominant body color, which is more subdued than the gaudy colors of most species of *Ulocentra*. The vernacular saffron darter reflects the same feature.

LITERATURE CITED

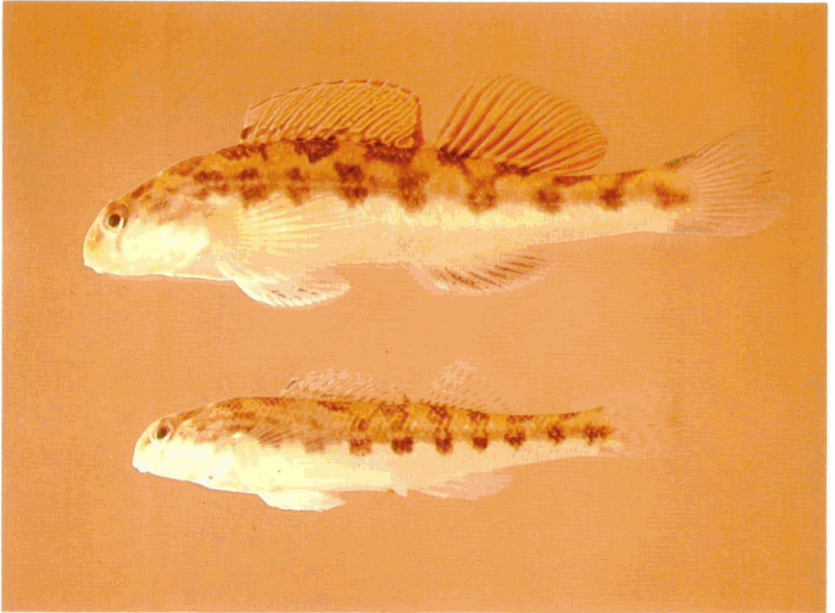
- Bailey, R. M., and D. A. Etnier. 1988. Comments on the subgenera of darters (Percidae) with descriptions of two new species of *Etheostoma* (*Ulocentra*) from southeastern United States. Misc. Publ. Mus. Zool. Univ. Michigan, 175:1-48.
- Bouchard, R. W. 1977. *Etheostoma etnieri*, a new percid fish from the Caney Fork (Cumberland) River system, Tennessee, with a redescription of the subgenus *Ulocentra*. Tulane Stud. Zool. Bot., 19:105-130.
- Braasch, M. E., and R. L. Mayden. 1985. Review of the subgenus *Catonotus* (Percidae) with descriptions of two new darters of the *Etheostoma squamiceps* species group. Occ. Pap. Mus. Natur. Hist. Univ. Kansas, 119:1-83.
- Burr, B. M. 1980. A distributional checklist of the fishes of Kentucky. Brimleyana, 3:53-84.
- Burr, B. M., and M. L. Warren, Jr. 1986. A distributional atlas of Kentucky fishes. Kentucky Nature Preserves Comm., Sci. and Tech. Ser. 4, 398 pp.
- Clay, W. M. 1975. The fishes of Kentucky. Kentucky Dept. Fish & Wildlife Resources, Frankfort, 416 pp.
- Gill, S. 1982. The fantail darter. Tropical Fish Hobbyist, 30:14-18.
- Hubbs, C. L., and K. F. Lagler. 1958. Fishes of the Great Lakes region. Cranbrook Inst. Sci. Bull. 26, 213 pp.
- Jenkins, R. E. 1976. A list of the undescribed freshwater fish species of continental United States and Canada, with additions to the 1970 checklist. Copeia, 1976:642-644.
- Kuehne, R. A., and R. W. Barbour. 1983. The American darters. Univ. Kentucky Press, Lexington, 201 pp.
- Page, L. M. 1983. Handbook of darters. T.F.H. Publications, Inc., Neptune City, New Jersey, 271 pp.
- Starnes, W. C., and D. A. Etnier. 1986. Drainage evolution and fish biogeography of the Tennessee and Cumberland river drainages. Ch. 10, pp. 325-361, *In*: C. H. Hocutt and E. O. Wiley (eds.), Zoogeography of North American freshwater fishes. Wiley-Interscience, New York, 866 pp.

Accepted for publication September 29, 1988

PLATE 1



Etheostoma flavum, adult male, 46 mm SL. Duck River system, Humphreys Co., TN, 1 April 1973. David A. Etnier, photo.



Etheostoma flavum, UMMZ 177629, adult male (above), 55 mm SL; adult female (below), 45 mm SL. Mill Creek, 1.5 km W of Wrigley, Duck River system, Hickman Co., TN, 18 May 1956. William L. Brudon, photo.