ETHEOSTOMA (OLIGOCEPHALUS) NUCHALE, A NEW DARTER FROM A LIMESTONE SPRING IN ALABAMA

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ABSTRACT

Etheostoma (Oligocephalus) nuchale is described from 71 specimens collected from a limestone spring in the Black Warrior River system near Bessemer, Jefferson County, Alabama. *E. nuchale* is known only from Glen Spring, the type locality, which is located above the Fall Line. It is compared to its nearest known relative, *E. swaini* (Jordan), from which it is geographically isolated. *E. swaini* does not normally cross the Fall Line, and is a wide-ranging species found along the Gulf Coastal Plain from the Ochlockonee River in Florida to the Amite River system of southeastern Louisiana and southern Mississippi. The species differ in details of body proportions, squamation, pigmentation, development of lateral line and cephalic sensory canals, certain fin-ray counts and habits.

On 21 March 1964, Dr. Ronald A. Brandon and Ron Altig collected three specimens of an undescribed darter while dip-netting for salamanders in Glen Spring at Bessemer, Jefferson County, Alabama. On 24 March 1964, we visited the spring and obtained 51 additional specimens. This distinctive species differs consistently from its nearest known relative, *Etheostoma swaini* (Jordan), in details of body proportions, squamation, pigmentation, development of lateral line and cephalic sensory canals, certain fin-ray counts, and habits.

Counts and measurements were obtained by methods defined by Hubbs and Lagler (1958: 19-26) unless otherwise noted. Techniques of Hubbs and Cannon (1935) were used in making measurements to the nearest 0.1 mm. Proportional measurements are expressed as thousandths of the standard length.

We wish to thank the following individuals who have aided us in this study: Dr. Ronald A. Brandon and Ron Altig of the University of Southern Illinois first collected specimens of this handsome new species and made them available to us; Dr. Herbert T. Boschung, Jr., our major professor, continually encouraged us and gave many helpful suggestions; Dr. Ralph Chermock of the University of Alabama criticized our manuscript in its early stages; Dr. Ralph Yerger of Florida State University permitted us to examine his unpublished data on *Etheostoma swaini* and also made radiographs for us; Dr. Royal D. Suttkus and John S. Ramsey of Tulane University made available to us a collection of the species described herein; Dr. Reeve M. Bailey of the University of Michigan criticized the final draft of our manuscript and made many helpful suggestions.

Etheostoma **nuchale**, sp. n.
Watercress Darter
(Fig. 1)

Material.—The holotype, University of Michigan Museum of Zoology, UMMZ 187523, an adult male, 39.4 mm in standard length, was collected by us on 24 March 1964 in Glen Spring at Bessemer, Jefferson County, Alabama (NE¼ SE¼ Sec 17, T 19S, R 4W) along county highway 20. In

the same collection we obtained the following specimens: the allotype, UMMZ 187524, an adult female 39.8 mm in standard length; 20 paratopotypes, UMMZ 187525; 20 paratopotypes, U. S. National Museum, USNM 259800-F1; and 9 paratopotypes, University of Alabama Ichthyological Collection, UAIC 1227. Twenty paratopotypes, Tulane University No. 34591, were collected on 9 September 1964 by Dr. Royal D. Suttkus, John S. Ramsey, and Francis L. Rose.

At present this species is known only from the type locality in the Black Warrior River system of Alabama.

Diagnosis.—A species of *Etheostoma* of the subgenus *Oligocephalus* (Bailey and Richards, 1963) distinguished by: lateral line incomplete, moderately straight; supratemporal canal incomplete; infraorbital canal usually incomplete; nape naked mesially; top of head, breast, and prepectoral areas naked; cheek largely naked but always with few to several embedded or exposed scales along posteroventral margin of eye; opercle with large exposed or embedded, ctenoid scales; body scales large, with 35-42 scales in the lateral series; 12-24 pored scales in lateral line; branchiostegal membranes moderately to narrowly conjoined, sometimes overlapping anteriorly. Fin-rays: dorsal VIII to XI (usually IX or X), 10 to 12; anal II (rarely III), 6 to 8; pectoral 11 or 12. Nape distinctly humped, usually decurving sharply to occiput. Breeding adults with a submarginal red band in spinous dorsal fin.

Description.—A moderately robust species with body slightly compressed; snout moderately pointed to somewhat rounded; pectoral fin shorter than head length; 11 to 14 branched caudal rays; 15 to 17 scale rows around caudal peduncle, of which 6 to 8 (usually 7) are above the lateral series and 6 to 8 (usually 7) are below; transverse scales are 10 to 12 (counted from origin of second dorsal fin posteroventrally to anal fin base); supratemporal canal incomplete,

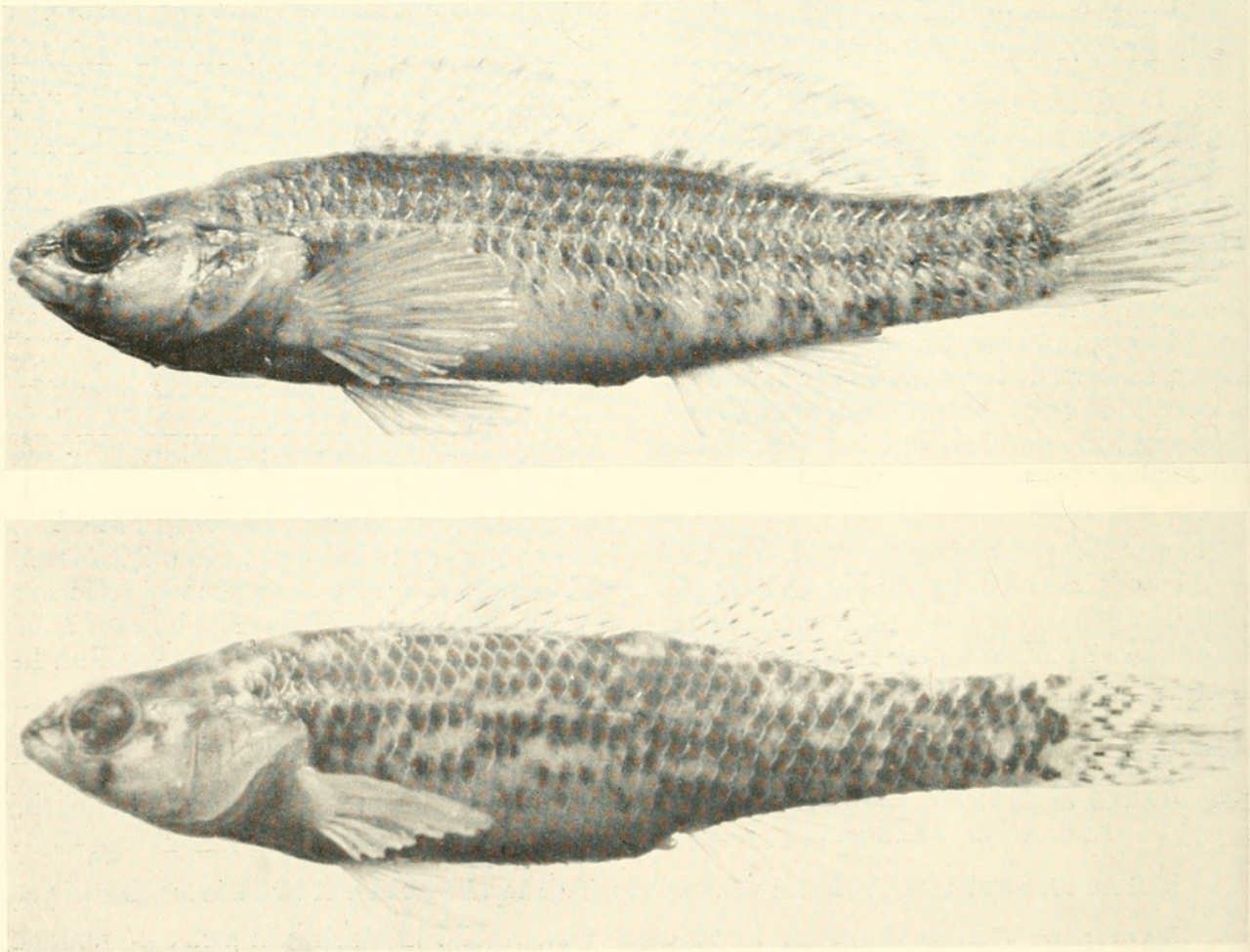

Figure 1. Top. *Etheostoma* **nuchale**, sp. n. Adult male holotype, 39.4 mm in standard length (UMMZ 187523).

Bottom. *Etheostoma* **nuchale**. Female allotype, 39.8 mm in standard length (UMMZ 187524).

TABLE 1.

Comparison of Proportional Measurements of Etheostoma **nuchale** *and E. swaini*[1] *(Expressed As Thousandths of Standard Length)*

Species	*Etheostoma nuchale*				*Etheostoma swaini*	
Museum number	UMMZ 187523 Holotype	UMMZ 187524 Allotype	UMMZ 187525 Paratypes	UMMZ 187525 Paratypes	UAIC 929, 1112, 1113, 1150, 1162 and 1184	UAIC 1060, 1090, 1162, 1180 and 1192
Sex	M	F	M	F	M	F
Number of specimens	1	1	10	10	10	10
Standard length, mm	39.4	39.8	34.9 (30.6-38.3)	36.6 (27.1-45.2)	35.9 (25.9-43.7)	37.3 (28.9-44.7)
Head length	281	282	280 (264-293)	274 (257-288)	294 (272-306)	295 (270-313)
Head width	167	164	176 (164-188)	171 (162-181)	162 (148-176)	163 (148-178)
Snout length	53	48	52 (45-61)	51 (45-57)	53 (43-60)	55 (46-59)
Orbit length	76	78	78 (72-86)	77 (67-88)	85 (75-93)	87 (79-96)
Fleshy interorbital width	61	50	59 (54-62)	54 (45-60)	55 (50-63)	57 (52-64)
Upper jaw length	79	78	73 (60-82)	72 (65-78)	83 (76-92)	81 (74-97)
Lower jaw to juncture of gill membranes	134	118	128 (110-152)	122 (102-140)	124 (115-133)	123 (114-135)
Head depth at occiput	188	196	199 (193-216)	194 (180-206)	186 (172-200)	190 (177-202)
Body depth at dorsal origin	226	241	228 (212-238)	228 (216-244)	211 (196-231)	210 (190-242)
Body width	150	153	148 (131-161)	148 (132-162)	142 (134-151)	152 (135-172)
Longest pectoral ray	239	234	243 (231-255)	239 (221-252)	274 (249-301)	268 (223-284)
Pelvic fin length	206	204	220 (193-234)	210 (187-237)	224 (191-239)	214 (191-224)
Pelvic fin base	38	38	37 (33-40)	35 (33-37)	40 (36-44)	35 (31-39)
Transpelvic distance	79	70	74 (69-78)	69 (66-72)	83 (80-86)	79 (76-87)
Interpelvic space	15	18	16 (13-20)	16 (13-20)	20 (14-23)	19 (16-22)
Pelvic insertion to juncture of gill membranes	180	191	186 (177-195)	180 (172-195)	190 (175-204)	199 (170-218)
Highest dorsal spine	117	123	125 (113-141)	109 (97-124)	138 (128-154)	125 (104-133)
Highest dorsal soft ray	165	153	167 (153-179)	156 (137-168)	167 (151-180)	158 (142-166)
First anal spine	79	78	85 (76-96)	74 (67-97)	85 (74-96)	80 (69-93)
Highest anal soft ray	152	156	166 (154-177)	155 (140-171)	153 (137-166)	137 (127-150)
Caudal peduncle length	223	262	247 (235-263)	248 (227-262)	260 (234-282)	259 (242-267)
Caudal peduncle depth	127	118	123 (118-130)	117 (102-130)	118 (106-128)	115 (108-129)
Caudal fin length	195	211	216 (190-248)	221 (191-246)	230 (210-262)	227 (202-246)

[1] All specimens of *E. swaini* from the Black Warrior River system

TABLE 2.
Frequency Distribution of Fin-Ray Counts in Etheostoma **nuchale** *and E. swaini*[1]

Species	Dorsal Spines							Soft Dorsal Rays					
	VIII	IX	X	XI	XII	N	Mean	10	11	12	13	N	Mean
E. nuchale	7	**32**	11	1		51	9.12	8	**30**	13		51	11.10
E. swaini			17	32	2	51	10.70		19	31	1	51	11.65

Species	Anal Spines			Anal Soft Rays				
	II	III*	N	6	7	8	N	Mean
E. nuchale	**50**	1	51	3	**41**	7	51	7.08
E. swaini	51		51	13	35	3	51	6.80

Species	Total Pectoral Rays (both sides)										Branched Caudal Rays							
	22	23	24	25	26	27	28	29	N	Mean	11	12	13	14	15	16	N	Mean
E. nuchale	**16**	4	31						51	23.29	1	**7**	14	22			44	13.30
E. swaini			7	5	33	2	3	1	51	25.61		3	12	24	5	1	45	13.76

[1] All *E. swaini* from Black Warrior River system
* Atypical fin has count of III, 7

TABLE 3.
Frequency Distribution of Scale Row Counts in Etheostoma **nuchale** *and E. swaini*[1]

Species	Scales In Lateral Series																
	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	N	Mean
E. nuchale						4	**12**	8	11	10	4	1	1			51	37.62
E. swaini						1	–	6	9	8	8	8	3	5	3	51	39.84

	Scales In Transverse Series					
	10	11	12	13	N	Mean
E. nuchale	23	**23**	5		51	10.65
E. swaini	2	35	13	1	51	11.25

	Scales Around Caudal Peduncle						
	15	16	17	18	19	N	Mean
E. nuchale	9	**40**	2			51	15.86
E. swaini		9	28	10	4	51	17.18

[1] All *E. swaini* from Black Warrior River system

TABLE 4. (Continued on opposite page)
Development of Lateral Line in Etheostoma **nuchale** *and E. swaini*[1]

Species	Pored Scales In Lateral Line													
	12	13	14	15	16	17	18	19	20	21	22	23	24	25
E. nuchale	3	3	4	5	7	4	7	**8**	1	7	–	1	1	
E. swaini														

Species	Unpored Scales In Lateral Series													
	3	4	5	6	7	8	9	10	11	12	13	14	15	16
E. nuchale													4	1
E. swaini	1	5	4	10	12	7	5	5	2					

[1] All *E. swaini* from Black Warrior River system

with 2 pores on each side branch; lateral canal complete with 5 (rarely 4 or 6) pores; postorbital, coronal, interorbital, posterior nasal, and anterior nasal pores present; preoperculomandibular canal complete with 10 pores; anterior portion of infraorbital canal separated from posterior portion in 85 per cent of specimens; infraorbital pores usually 3 + 5 (posterior plus anterior pores) but varies from 1 + 5 to 4 + 6 with several intermediate combinations. In two of 51 specimens the infraorbital canal is interrupted twice with pore counts of 3 + 1 + 4 and 2+ 1 + 3; one specimen has the canal interrupted three times with pore counts of 1 + 2 + 2 + 3; infraorbital canal complete with 8 pores in 15 per cent of specimens. The upper lip is bound to the snout by a well developed frenum; branchiostegal rays 6; vertebrae 34 or 35 (mean = 34.4) in counts made from radiographs of 15 specimens; holotype with 34 vertebrae; nuptial tubercles absent; genital papilla of breeding females is a short, blunt, somewhat conical tube; pored portions of lateral line conspicuous, being nearly devoid of pigment; humeral region beneath the semitransparent opercular membrane is darkened; sexual dimorphism is pronounced; general body outlines are shown in Fig. 1. Body proportions are given in Table 1. In Tables 2-4, counts for the holotype appear in boldface.

Coloration.—Sexual dichromatism is pronounced. Breeding males are brilliantly colored, breeding females are plain. The following description is of the holotype, a breeding male. Notes were made immediately after preservation. Five dark orbital bars are present on the head. A black bar which originates behind and just below the center of the eye extends backward and slightly upward almost to the origin of the lateral line. This postorbital bar is broken immediately anterior to the upper portion of the preopercular margin. A preorbital dark bar which originates in line with the center of the eye extends abruptly downward and forward, passing just below the anterior naris; it then continues along the outer edge of the premaxillary frenum and ends on the upper border of the premaxilla. The lower lip is densely punctated with melanophores near its midline. A dark suborbital bar subequal in width to the pupil extends downward and slightly forward and ends on the interopercular margin. In the interorbital area is a very short supraorbital bar which begins on the iris slightly posterior to the mid-dorsal edge of the orbit and extends about one-third the distance to the mid-dorsum. Halfway between the supraorbital and postorbital bars is a dark bar which extends obliquely backward to the supratemporal canal at a 45 degree angle to the postorbital bar. The cheek and breast are light gray with distinct, evenly scattered, stellate melanophores. The isthmus and branchiostegal membranes are darker than the breast. There is no prepectoral spot; the melanophores at the pectoral fin base are widely and evenly distributed. The humeral region beneath the semitransparent opercular membrane is dark. The lateral line is without dark pigment, and forms a conspicuous light line. The pupil is blue-gray. The iris is metallic gold. Each body scale is margined with melanophores. A large dark spot is present in the center of most body scales giving an appearance of horizontal lines along the body (Fig. 1). The genital papilla and the region immediately surrounding the anus is white. The

TABLE 4. (Continued)
Development of Lateral Line in Etheostoma **nuchale** *and E. swaini*[1]

Pored Scales In Lateral Line														
26	27	28	29	30	31	32	33	34	35	36	37	38	N	Mean
													51	17.21
		2	2	5	10	7	5	8	5	5	1	1	51	32.65

Unpored Scales In Lateral Series													
17	18	19	20	21	22	23	24	25	26	27			N	Mean
4	6	3	7	10	3	5	2	4	1	1			51	20.41
													51	7.06

[1] All *E. swaini* from Black Warrior River system

belly is bright red-orange ventrolaterally. On the mid-venter the red-orange is broken by a narrow light stripe which extends from the anal area to the interpelvic region. The bright red-orange of the belly fades abruptly into light yellowish-white at the fourth scale row below the lateral line. There are six, poorly defined vertical bars best developed on their lower halves on the posterior half of the body. The bars are two to three scale rows wide, bluish-brown in color, and are separated by poorly defined orange bars. Ventrally the red-orange of the belly extends posteriorly uninterrupted to the middle of the anal fin base where it is broken by the first complete vertical bar. The nape has an irregular-edged, light yellow stripe which extends uninterrupted along the mid-dorsum from the base of the first dorsal spine to the occiput. There are seven highly irregular dorsal saddles which are two to four times wider than the interspaces. There are three indistinct, black spots in a vertical series at the caudal fin base. Immediately behind the basicaudal spots are two large, round orange spots, one above the other. The orange spots extend a short distance onto the caudal fin. Except for the orange spots, the basal third of the caudal fin is blue; remainder of fin is clear. Melanophores on the caudal fin are confined chiefly to the rays while chromatophores are on rays and membranes. The anal fin is bright blue. The pelvic fins are blue basally becoming lighter toward the tips. The pectoral fins are largely clear, becoming light blue basally. Pectoral rays are evenly outlined with melanophores. Listed in sequence from fin margin to fin base, the first dorsal fin has the following color bands: (1) a marginal blue band, (2) a submarginal red-orange band, (3) another blue band, and (4) a basal red band. Listed in like order, the second dorsal fin has the following color bands: (1) a wide marginal blue band, (2) a submarginal light orange band, (3) an intense red band, (4) a blue band, and (5) a basal red band.

In breeding male paratypes the coloration of the cheeks, breast, and prepectoral region varies from immaculate white to dark gray. The belly is light orange, red-orange, or bright red. Prepectoral spots are present or absent. Larger specimens usually have the nape mottled while most smaller specimens possess a conspicuous light stripe extending along the mid-dorsum from the base of the first dorsal spine to the occiput. A few specimens have a vertical red bar near the middle of the caudal fin. Patches of red pigment are sometimes present on the anal fin. Dorsal saddles are highly irregular, varying in number from 4 to 9.

Females, in contrast to the brilliant nuptial colors of males, are plain. Dominant colors in females are brown and black which contrast sharply with the white of the belly, breast, cheeks, and other light areas. Melanophores are concentrated in the center of many body scales but do not produce horizontal lines as in males. The dorsum and sides of most females have interspersed black, brown and white spots which form no definite pattern (Fig. 1). Head coloration is similar to that of males. Five orbital bars are present. The nape is irregularly mottled in some specimens while most possess a prominent predorsal light stripe. The prepectoral spot is present or absent. Dorsal saddles are usually highly irregular, varying in number from 3 to 9. The median fins have rows of discrete black spots on the rays. The black spots are boldly contrasted against the clear interradial membranes. The pectoral fin rays are usually margined with melanophores while the interradial membranes are clear. The pelvic fins have melanophores on rays and membranes. The spinous dorsal is the only fin with bright color in breeding females, being similar to males but much subdued.

Habitat and habits.—The type locality, Glen Spring, is a limestone spring which issues from the base of Glen Hill and forms a small, clear creek 2-9 feet wide and 2-18 inches deep. The creek flows into a man-made lake approximately 200 yards north of the spring basin. The estimated discharge of the spring at the date of collection was 500 gallons per minute. This flow is partially dependent upon recharge from local precipitation. The flow was greatly reduced during a long dry period in November 1964 but was restored December 1964, after the drought ended. The temperature of the spring varies narrowly between 16 and 18 degrees Centigrade. The elevation at the spring is 480-500 feet above sea level. Glen Spring is located within the small portion of the Valley and Ridge Physiographic Province which extends into the eastern part of the Black Warrier River Basin.

The outflow creek is choked with dense growths of watercress, *Nasturtium officinale.* The stream bottom consists of angular gravel in riffle areas and silt and mud in areas of reduced flow and heavy watercress growth. *Etheostoma nuchale* is very habitat specific; it is found only among the watercress. We have observed *nuchale* as it perched upon the leaves and roots of watercress at mid-water depths. There it feeds upon the abundant snails, crustaceans, and insect larvae which inhabit the spring and outflow creek. In aquaria, *nuchale* moves about freely, perching here and there upon roots and leaves of aquatic plants. It does not normally inhabit the bottom as do most darters. *E. nuchale* can be collected almost anywhere along the stream course above the lake. It is absent below the lake where the stream becomes heavily polluted. The stream below the lake runs into Halls Creek which flows through a residential section of Bessemer, Alabama.

We have collected in other springs in the Birmingham-Bessemer area but have not taken *nuchale.* Most of the springs have either been exploited for public or industrial water supplies or have otherwise been altered. Glen Spring is located approximately twenty yards off the present Jefferson County Hwy. 20. The outflow creek closely parallels the highway. *E. nuchale* is in danger of extinction on the basis of its limited habitat alone. At present we are contemplating the transplantation of *nuchale* to other suitable springs in the area.

E. nuchale is abundant and very successful in the spring basin and outflow creek. Associates of *nuchale* are, in order of decreasing abundance, *Semotilus atromaculatus* (Mitchill), *Lepomis cyanellus* Rafinesque, *Etheostoma whipplei artesiae* (Hay), and *Campostoma anomalum* (Rafinesque).

Relationship.—Etheostoma nuchale is apparently a highly specialized derivative of *E. swaini* (Jordan), from which it is geographically isolated. *E. nuchale* is known only from the type locality which is above the Fall Line in the Black Warrior River system of Alabama. *E. swaini* normally does not cross the Fall Line and is a wide-ranging species found along the Gulf Coastal Plain from the Ochlockonee River in Florida to the Amite River system of Southeastern Louisiana and southern Mississippi (R. W. Yerger, personal communication). We have made no attempt to study variation of *E. swaini* throughout its range as this problem is currently being investigated by Dr. Ralph W. Yerger of Florida State University. Since *E. nuchale* is such a distinctive species, it has been compared only with specimens of *swaini* from the Black Warrior River system (Tables 1-5). All specimens of *swaini* are deposited in the University of Alabama Ichthyological Collection and have the following accession numbers: UAIC 677, 679, 929, 1060, 1112, 1113, 1150, 1161, 1162, 1180, 1192, 1225, 1582, all from Tuscaloosa Co., Ala.; UAIC 1184 and 1190 from Fayette Co., Ala.

Breeding males of *nuchale* and *swaini* have the same basic color pattern with the colors being more intense in *nuchale.* Females of *nuchale* and *swaini* differ markedly in color pattern: in *swaini* there are dark spots in the center of most body scales which usually produce definite horizontal lines along the body (Fig. 2); in *nuchale* there are many darkened scales but horizontal lines are not usually developed (Fig. 1). Other color differences are also apparent.

Seventy-three per cent of 51 specimens of *swaini* had either embedded or exposed scales on the nape. In *nuchale* the nape is always naked mesially.

TABLE 5.

Comparison of Etheostoma **nuchale** *and E. swaini*[1]

Character	*E. nuchale*	*E. swaini*
Supratemporal canal	Widely interrupted	Complete
Infraorbital canal	Usually interrupted	Complete
Pored lateral-line scales	12-24	28-38
Unpored lateral-line scales	15-27	3-11
Dorsal spines	VIII-XI ($\bar{x}$ = 9.12)	X-XII ($\bar{x}$ = 10.70)
Total pectoral rays	22-24 ($\bar{x}$ = 23.29)	24-29 ($\bar{x}$ = 25.61)
Scales in transverse series	Usually 10 or 11	Usually 11 or 12
Scales around caudal peduncle	15-17 ($\bar{x}$ = 15.86)	16-19 ($\bar{x}$ = 17.18)

[1] All *E. swaini* from Black Warrior River system

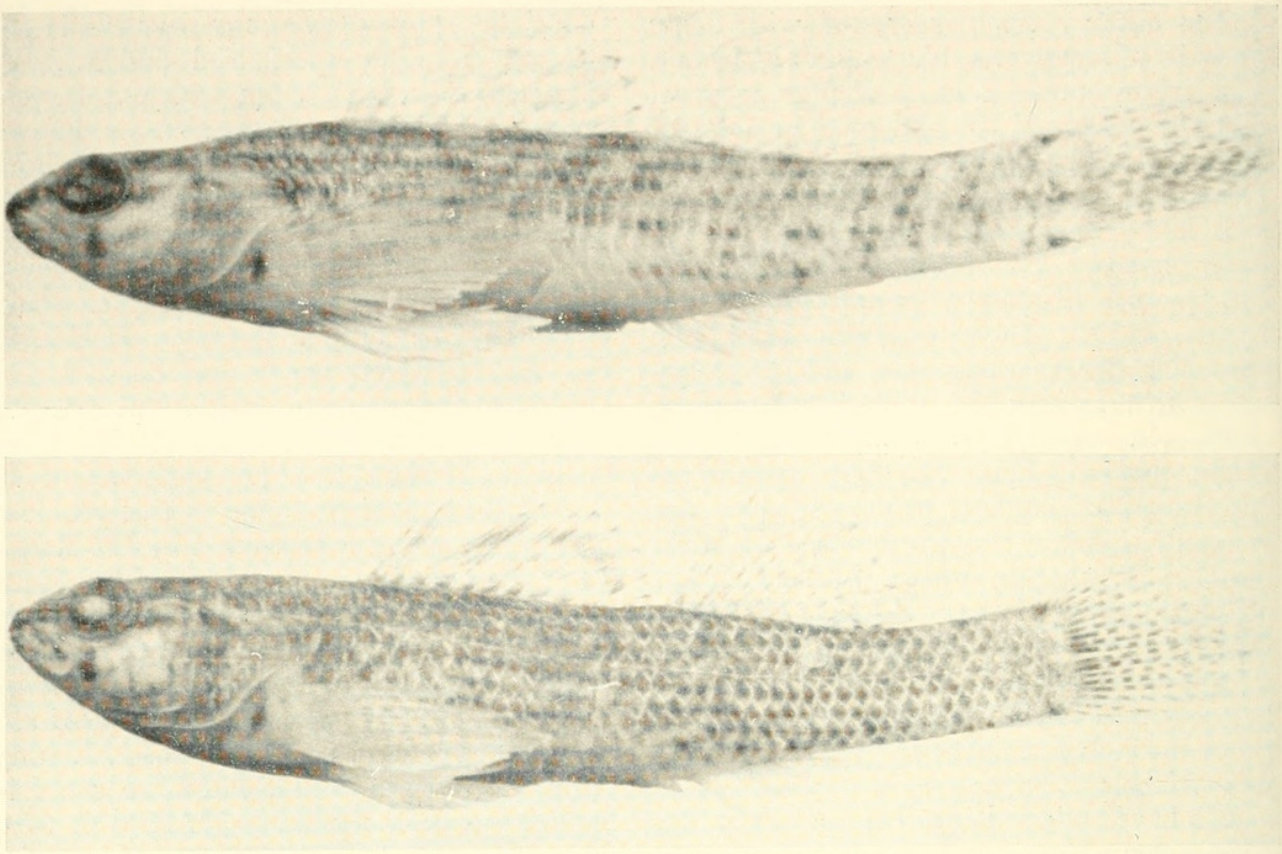

Figure 2. Top. *Etheostoma swaini.* Adult male, 41.8 mm in standard length, from Black Warrior River system (UAIC 1184).
Bottom. *Etheostoma swaini.* Adult female, 44.7 mm in standard length, from Black Warrior River system (UAIC 1090).

Body proportions (Table 1) as well as visual comparisons (Figs. 1-2) show that *nuchale* is much more robust than the slender, stream-dwelling *swaini.* Since *nuchale* lives among dense growths of watercress where water movement is very slow, the deep, robust body is probably a habitat adaptation. A distinctive feature of *nuchale* is the humped nape which decurves sharply to the occiput. The humped nape does not seem to be associated with breeding activities since it is well-developed, even in juveniles of *nuchale.* It is absent in *swaini.* It is interesting to note that a few gravid females of *nuchale* were present in collections made from March through July. Under relatively constant environmental conditions of the spring, the breeding season of *nuchale* may be extended. We suspect that *swaini* of the Black Warrior River system breeds in early spring.

The following characters of *nuchale* probably represent increased specialization over those of *swaini*: (1) reduced number of pored lateral-line scales, (2) incomplete supratemporal canal, (3) incomplete infraorbital canal, (4) reduced number of pectoral rays and dorsal spines, (5) increased sexual dimorphism and dichromatism, and (6) highly specific habitat. *E. nuchale* has probably evolved, as an isolated population, in response to relatively constant conditions encountered in the spring environment.

Name.—The specific name, *nuchale,* "pertaining to the nape", calls attention to the light predorsal area and to the humped nape. The vernacular name, "watercress darter," is suggested in reference to its habitat.

Literature Cited

Bailey, R. M., and W. J. Richards. 1963. Status of *Poecilichthys hopkinsi* Fowler and *Etheostoma trisella,* new species, Percid fishes from Alabama, Georgia, and South Carolina. *Occ. Papers Mus. Zool. Univ. Mich.,* 630: 1-21.

Hubbs, C. L., and M. D. Cannon. 1935. The darters of the genera *Hololepis* and *Villora. Misc. Publ. Mus. Zool. Univ. Mich.,* 30: 1-93.

———, and K. F. Lagler. 1958. Fishes of the Great Lakes region. Cranbrook Inst. Sci. Bull. 26: xiii + 213 p.