CYPRINID FISHES OF THE SUBGENUS *CYPRINELLA* OF *NOTROPIS*. III. VARIATION AND SUBSPECIES OF *NOTROPIS VENUSTUS* (GIRARD)

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The complex of forms which are here considered as a single species, *Notropis venustus*, has been treated rather superficially for many years, resulting in differential usage of nomenclature, as well as confusion with regard to species status. In one hundred years since the original description of *Cyprinella venusta* (Girard, 1856), ten additional names have been bestowed on populations of this minnow, in spite of (or perhaps because of) a relative scarcity of collections from the southeastern United States. Until recently, four of these names represented nominal species to many workers (*venustus, cercostigma, stigmaturus, eurystomus*), or at least subspecies, one was never certain which. Bailey, Winn and Smith (1954) were the first to express in print their doubt concerning the status of the four names, and they recognized only one species, *Notropis venustus*, pending investigation.

Following the 1948 decision of the International Commission on Zoological Nomenclature, which temporarily formalized the rule of line priority, the name *notatus*, which preceded *venustus* in Girard, 1856 (p. 198), was used for this species, but fortunately did not find its way into print. In 1952, the Commission reversed itself, and Clark Hubbs, as first reviser (1954b), placed *notatus* in the synonymy of *venustus*.

Although its caudal spot makes *Notropis venustus* one of the most easily recognized species of *Notropis*, the variation in shape and intensity of this spot, together with considerable variation in body proportions, has led to confusion and the unwarranted naming of species. This paper clarifies the situation by pointing out the patterns of variation and by indicating rather precisely the validity of the acceptable subspecies. Three subspecies with five races are recognized.

Materials and Methods

The writer is grateful to the following institutions and their respective staffs for making available materials under their care: Dr. Edward C. Raney, Cornell University; Dr. Reeve M. Bailey, Museum of Zoology, University of Michigan; Dr. Leonard P. Schultz, Dr. Ernest A. Lachner and Mr. Robert H. Kanazawa, United States National Museum; Dr. Royal D. Suttkus, Tulane University.

Counts and measurements were made as described by Hubbs and Lagler (1947), with the exception of postdorsal length (dorsal origin to caudal base) and the distance from dorsal origin to lateral line. Only specimens of between 50 and 60 mm were used for proportional measurements. As in my study of *Notropis spilopterus* (Gibbs, in press), when adequate samples were available, no more than ten speci-

mens were counted from any single collection.

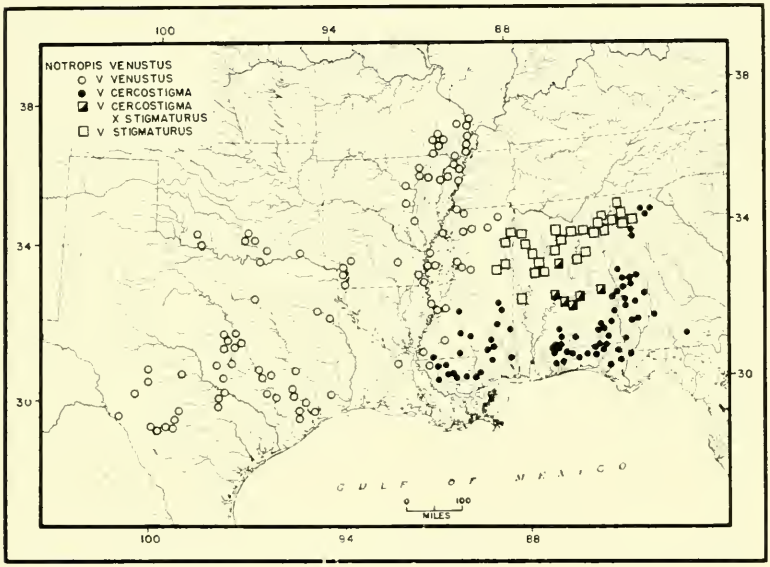
Because of the healthy skepticism which exists at present, it is necessary to comment on the terms "subspecies" and "race" as they are used here. Because of the ample evidence, which need not be cited here, that characters may be affected directly by the environment, any designation of an infraspecific category must be subject to doubt unless genetic evidence is available. If this sort of evidence is not forthcoming, then it is necessary to choose between two expedients: (1) merely giving the data for what it is worth, letting the reader decide whether the results are due to genotypic or to phenotypic variation or both; (2) calling attention to the major segments of a species by giving them categorical recognition on the assumption (perhaps wrong) that the differences have a genetic basis. The latter is followed here due to the conviction that the subspecies is a real and important category, and that the naming of these has value in the fact of pronouncement, if nothing else. That individual cases prove to be judged wrongly is not sufficient reason for eliminating the whole procedure.

The *defining* of the infraspecific categories is another matter. In particular it is difficult to say what is to be a subspecies and what a lesser category. It is this writer's tendency to feel that, if a meristic character has the same mode and distribution in samples from a number of adjacent river systems and those are different from the modes and distributions of another homogeneous-appearing group of samples, then the two are subspecies. This is exemplified in this paper by *Notropis v. venustus* and *N. v. cercostigma* (see Table 4) in which homogeneity of eastern and western Gulf populations is evident, as is the *difference* in the mode and distribution of each. When a single river system varies rather widely from the rest, then the actual separation must be relatively larger. In such instances, the criteria of Ginsburg (1938) are as near an approach to objectivity as any, although some personal judgment should be exercised. I draw my lines slightly higher than does Ginsburg. The subspecies *N. v. stigmaturus*, found only in the upper Alabama and Tombigbee rivers of the Apalachicola system, typifies this procedure (see Tables and Figures).

Below what I judge to be the subspecies category, I use somewhat less restraint. If a single river system varies noticeably in one or more characters, it may be called a "race" if the separation falls below an average of about 80 per cent and the modes are distinct and different. Thus the Upper Chattahoochee Race of *N. v. cercostigma* is rather distinctive in the number of lateral-line scales and pectoral rays, and in having 8 or 9 anal rays in almost equal numbers. The Red-Lower Miss. Race, however, differs most in body depth and related characters from the others of the western Gulf subspecies and is less well-defined meristically. Both of these differ considerably more from the others of the particular subspecies than these do among themselves (see Tables and Figures).

This incomplete discussion, then, should indicate the reasons for

my formalized recognition of certain segments of *Notropis venustus*. Had there been any convincing suggestions of gradients, no particular status would have been applied to these segments other than to recognize clines. Thus the view is held that these segments have a genetic basis, even if this should be disproved eventually.



Map 1. Distribution of collections examined of *Notropis venustus*.

NOTROPIS VENUSTUS (GIRARD)

Diagnosis.—A species of *Cyprinella* (Gibbs, 1957) with a pronounced dark basicaudal spot; a terminal or subterminal mouth; 1,4-4,1 teeth; 8 anal rays (often 9 in the upper Chattahoochee River); 15-2-11 predorsal circumferential scales; usually with no contrastingly darker pigment in the posterior dorsal membranes, the melanophores gradually increasing in density to the rear (except *N. v. stigmaturus*, which lacks the melanophores on the first three membranes and has a pronounced concentration in the last two). Comparisons will be made under each subspecies.

Description.—Teeth 1,4-4,1, hooked, the cutting surfaces narrow and concave, with or without serrations. Anal rays 8; pectoral rays usually 14 or 15. Dorsal fin moderate in size, the first or second ray longest; anterior and posterior rays almost even in the depressed fin; origin nearer caudal base than snout.

Lateral-line scales variable in races and subspecies, usually 36 to 43. Predorsal circumferential scales usually 15-2-11; caudal peduncle scales 7-2-5. Scales not crowded before dorsal. Exposed edges of lateral scales higher than wide, especially just above and below the lateral line.

Head triangular, snout rather sharp. Orbit usually 7-8% of standard length, very slightly shorter than snout, about 3½ to 4 in head. Mouth terminal or subterminal, oblique, moderately large, end of upper jaw reaches about to anterior margin of orbit, slightly longer than orbit.

Body form slender to moderately deep, subterete, caudal peduncle depth varies similarly to body depth. Lateral line slightly decurved from opercular margin to below dorsal fin.

Tubercles in breeding males (fig. 6) not enlarged, crowded on top of head, on end of snout, and between eye and upper jaw, a hiatus between those of head and snout. More than one row of tubercles on each chin ramus. Tubercles of notal ridge crowded and about similar in size to those of head, becoming less dense and smaller toward dorsal origin. Small tubercles on all body scales except belly, commonly in a row on exposed margins. A row of tubercles on each ray of all fins, following branchings, less prominent on dorsal and caudal.

Coloration.—The most prominent character in this species is the black basicaudal spot, which is variable in intensity and in dimensions from race to race and from stream to stream, and is probably partially under genetic and partly under environmental control. A leaden lateral band, of distinctly different intensity than the caudal spot, runs forward to below the dorsal, where a narrow line from its upper end extends anterior to the operculum. Between the narrow line and the lateral line the melanophores become thinned out, but are still more dense than on most of the body, suggesting a wide continuation of the lateral stripe. Scales narrowly outlined in black, appearing diamond-shaped. Belly unpigmented except sides of anal fin base, where pigment is most prominent at the posterior edge of the fin and a short distance rearward on the lower part of the caudal peduncle. Dark humeral bar absent. Head darkly pigmented dorsally and laterad to the level of the lower edge of the orbit on the snout, and above eye level behind the eye. Melanophores may be lightly scattered as far as the lower part of the operculum. A narrow, deep-lying dark bar between chin rami. Lips moderately pigmented, the lower less than the upper.

Remaining fins free of pigment except for that part of the basicaudal spot which may extend onto the caudal fin and a narrow line behind each leading pectoral ray. Dorsal fin with scattered melanophores on all membranes in adults, the density becoming gradually greater posteriorly. The pigmentation is, therefore, stronger on the last two membranes, but is not prominent due to the gradual increase in density. This is at variance with the majority of species of the subgenus *Cyprinella*. *N. v. stigmaturus*, however, displays the typical subgeneric form of this character, the posterior membranes being prominently pigmented, while the first three almost never show pigment.

In breeding males, the unpaired fins become yellow, and all fins display the milky pigment characteristic of the species of *Cyprinella*.

Furthermore, these males develop a diffuse spot due to a concentration of dark pigment beneath the scales just above the lateral line and about midway between the dorsal origin and the operculum.

NOTROPIS VENUSTUS VENUSTUS (GIRARD)

Western Blacktail Shiner

Cyprinella venusta—Girard, 1856: 198 (orig. descr., Rio Sabinal, Tex.); 1858b: 54 (char., plate); Jordan and Copeland, 1876: 153; Jordan, 1878 422; Cope, 1880: 38 (Texas); Schrenkeisen, 1938: 131 (char., distr.).

Cliola venusta—Jordan and Gilbert, 1883: 178 (char., distr., syn.).

Erogala venusta—Jordan, Evermann and Clark, 1930: 130 (distr., syn.).

Notropis venustus—Jordan, 1885: 25; 1886: 119 (types examined; comparisons); Jordan and Gilbert, 1887: 14, 15 (Red, Sabine, Brazos, Colorado systems, Tex.); Everman, 1893: 79 (Texas); Evermann and Kendall, 1894: 83, 86, 92, 102 (Texas); Meek, 1895: 77, 82 (Arkansas distr.); Jordan and Evermann, 1896a: 255 (distr., syn.); 1896b: 257, 274 (char., distr., syn.); Meek, 1896: 343 (Red and St. Francis systems); Evermann, 1899: 308 (Neches system, Tex.); Fowler, 1910: 281 (variation); Jordan, 1928: 369 (distr.); Bailey, Winn and Smith, 1954: 128; Hubbs, 1954a: 73 (*texanus* in syn.); 1954b: 280 (*notatus, texanus* in syn.); Riggs and Smithpeter, 1954: 53 (L. Texoma, Okla.).

Notropis, venustus venustus—Lamb, 1941: 44 (San Jacinto system, Tex.); Paden, 1948: 38 (Okla., compared with E. Ozark form); Baughman, 1950: 130 (Texas); Hubbs, Kuehne and Ball, 1953: 223, 226, 243 (Guadalupe system, Tex.; habitat, hybridization with *N. lutrensis*); Knapp, 1953: 62 (Texas distr.).

Cyprinella notata—Girard, 1856: 198 (orig. descr., Rio Seco, Tex.); 1858a: 269 (char., plate); Jordan and Copeland, 1876: 153; Jordan, 1878: 422; Schrenkeisen, 1938: 131 (char., distr.).

Cliola notata—Jordan and Gilbert, 1883: 177 (char., distr., syn.).

Erogala notata—Jordan, Evermann and Clark, 1930: 130 (distr., syn.).

Notropis notatus—Jordan, 1885: 25; 1886: 124 (types examined); Call, 1887: 76 (Reynolds, Shannon, Texas cos., Mo.); Jordan and Gilbert, 1887: 20 (Colorado system, Tex.); Evermann and Kendall, 1894: 83, 86, 92, 103 (Tex.); Jordan and Evermann, 1896a: 255 (distr., syn.); 1896b: 257, 274 (char., distr., syn.); Pratt, 1923: 79 (char., distr.); Fowler, 1945: 234 (Tex).

Cyprinella texana (misidentifications)—Girard, 1856: 198 (orig. descr., Rio Salado and Turkey Creek, Tex.); 1858b: 55 (char., plate); Jordan and Copeland, 1876: 153; Jordan, 1878: 422.

Notropis texanus (misidentifications)—Jordan and Gilbert, 1887: 17 (Trinity and Brazos systems, Tex.); Evermann and Kendall, 1894: 86, 92, 103 (Tex.); Jordan and Evermann, 1896a: 255 (distr., syn.); 1896b: 257, 274 (char., distr., syn.); Fowler, 1910: 281 (variation); Pratt, 1923: 79 (char., distr.).

Erogala texana (misidentification)—Jordan, Evermann and Clark, 1930: 130 (distr., syn.).

Luxilus stigmaturus (misidentification)—Hay, 1883: 71 (Big Black R., Miss.).

Cliola urostigma—Jordan and Meek, 1885: 475 (orig. descr.; Colorado and Brazos systems, Tex.).

Notropis cooglei—Hildebrand and Towers, 1928: 18 (orig. descr., Greenwood, Miss.).

Notropis cercostigma (misidentification)—Hubbs and Ortenburger, 1929: 78 (Ark.).

Types.—Girard's original *Cyprinella venusta* is represented by two sets of extant syntypes at the Academy of Natural Sciences of Philadelphia and the Museum of Comparative Zoology at Harvard University. One of the Philadelphia specimens, ANSP 3035, a male, 50.2 mm, is here designated lectotype; another syntype bears the number ANSP 3036. These were labeled as having been collected in the Rio Sabinal, Texas, by Dr. C. B. Kennerly and received from the Smithsonian Institution (No. 140). Both specimens are in rather poor condition, but have the basicaudal spot well-developed. The syntypes at Harvard are catalogued as MCZ 1695 and are accompanied by a replacement label which reads: *Cyprinella venusta*—2 sp., now = *Erogala venusta* (Girard), Rio Sabinal, Texas, C. B. Kennedy probably a misspelling of Kennerly, Smithsonian Institution 1861.

The following types of other nominal species have been checked.

Cyprinella notata Girard. USNM 136. Rio Seco, Texas, 1853. C. B. Kennerly. Jordan (1886) noticed that one of the original three specimens was *Notropis lutrensis* (Baird and Girard), and this was removed as USNM 162720 by Clark Hubbs, who also placed *notatus* in the synonymy of *venustus* (Hubbs, 1954b). The lectotype, which

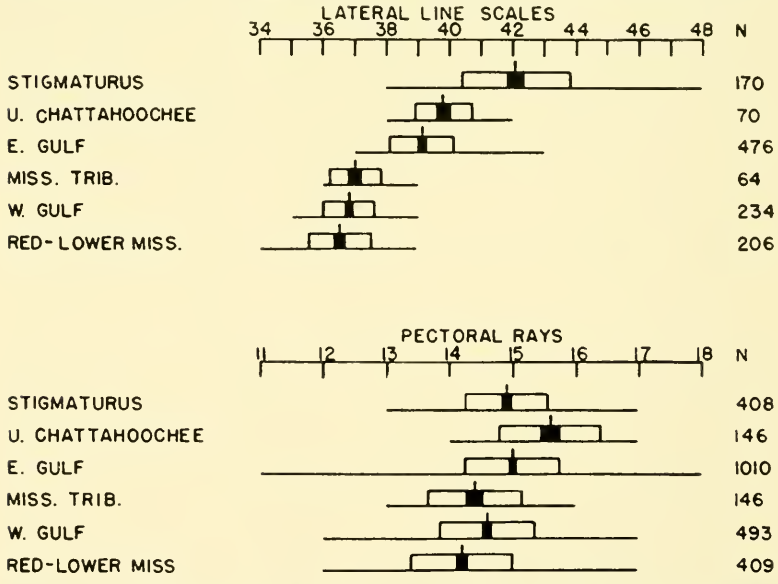


Figure 1. Graphic analysis of some meristic characters of *Notropis venustus*. Horizontal line = range. Vertical line = mean. Open rectangle = one standard deviation on each side of mean. Black rectangle = two standard errors on each side of mean.

is herein designated, retains USNM 136; the other specimen of *notatus* now is *Notropis venustus* USNM 163955.

Cyprinella texana Girard. USNM 128. Rio Salado, Texas. Clark. This name has also been included in the synonymy of *venustus* by Clark Hubbs (1954a). Royal D. Suttkus has studied the available syntypes of this nominal species and has found that none of them is a *Cyprinella* at all. He will discuss this in a forthcoming publication. The name, therefore, is included in the synonymy of *N. v. venustus* only as a misidentification.

Cliola urostigma Jordan and Meek. USNM 20446. Fort McKavit = McKavett , Texas, W. W. Anderson; and USNM 17812. Clear Creek, Waller Co., Texas, December 14, 1876, Kumlein and Earll. The counts by Jordan and Meek (1885) were apparently made on specimens from USNM 20446. The lectotype here designated, a female, 76.3 mm, will retain this number. The remaining eight syntypes from that collection are recatalogued as USNM 163952.

Notropis cooglei Hilderbrand and Towers. Holotype USNM 88379. Pelucia Creek, Greenwood, Miss., June 19, 1925, I. L. T. Towers . Numerous paratypes are also present in the U. S. National Museum, and several have been sent to the Museum of Zoology, University of Michigan. The anal ray count in the original description, given as 10, is presumably in error, as the holotype has the typical count of

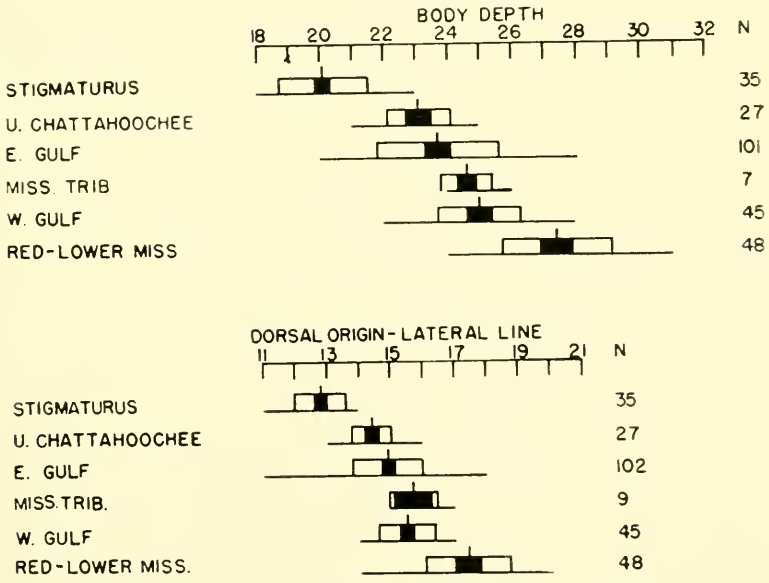


Figure 2. Graphic analysis of some proportional characters of *Notropis venustus*, expressed as percent of standard length. See Figure 1. for explanation.

eight, and since no counts of 10 have been recorded in this study for the species *venustus*. This form is the "Red-Lower Miss. Race" of *Notropis v. venustus*, which is discussed later.

Number of collections examined by river systems.—"Red-Lower Miss. Race": Lower Mississippi tribs. (S. Illinois to Louisiana), 39; Red, 12. Western Gulf Race: Ouachita, 2; White, 23; St. Francis, 12; Sabine, 3; Neches, 1; Trinity, 3; San Jacinto, 8; Brazos, 24; Colorado (of Texas), 8; Guadalupe, 2; Nueces, 6; Rio Grande, 2.

Comparative diagnosis.—Only three species of *Cyprinella* are found in the range of this subspecies. In much of its distribution it occurs adjacent to or with *N. lutrensis*. In tributaries to the lower Mississippi River in Mississippi and Louisiana it is associated with a race of *N. camurus*, and in the Ouachita, Black, and St. Francis, *N. whipplei* is a cohabitant. *N. v. venustus* may be distinguished from all these by the presence of a black basicaudal spot and eight anal rays, instead of nine. *N. lutrensis* further usually has 4-4 teeth and develops red fin pigment in breeding males. *N. whipplei* is very similar in body form, but usually has 13-2-11 predorsal circumferential scales instead of 15-2-11, and the last two dorsal membranes are prominently pigmented. *N. camurus* has a depigmented area along the caudal base which *venustus* lacks, and also has prominently darkened posterior dorsal membranes. *N. camurus* from the lower Mississippi River also differs from *N. v. venustus* in several proportional characters. The

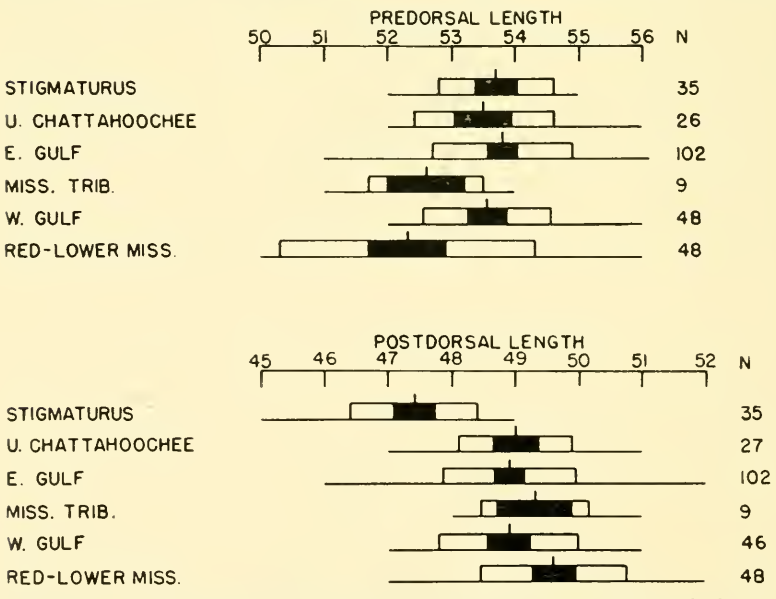


Figure 3. Graphic analysis of some proportional characters of *Notropis venustus*, expressed as percent of standard length. See Figure 1. for explanation.

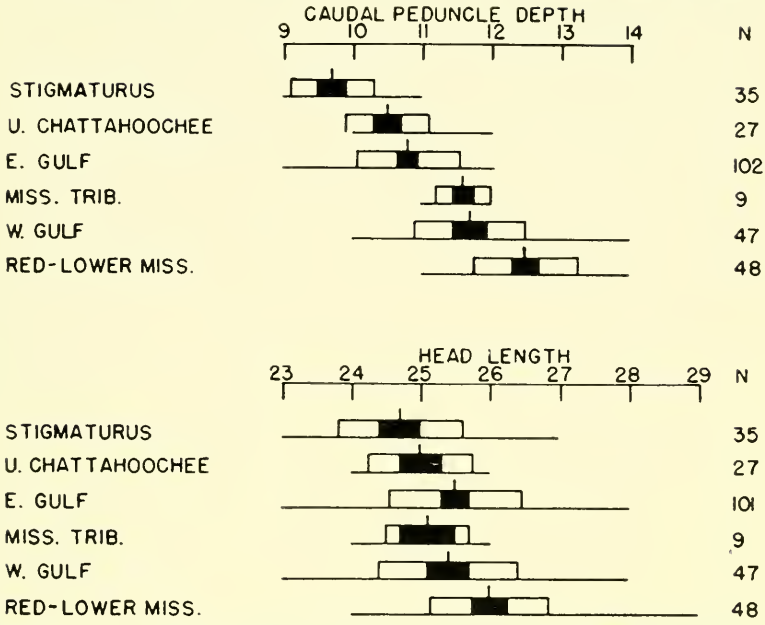


Figure 4. Graphic analysis of some proportional characters of *Notropis venustus*, expressed as percent of standard length. See Figure 1. for explanation.

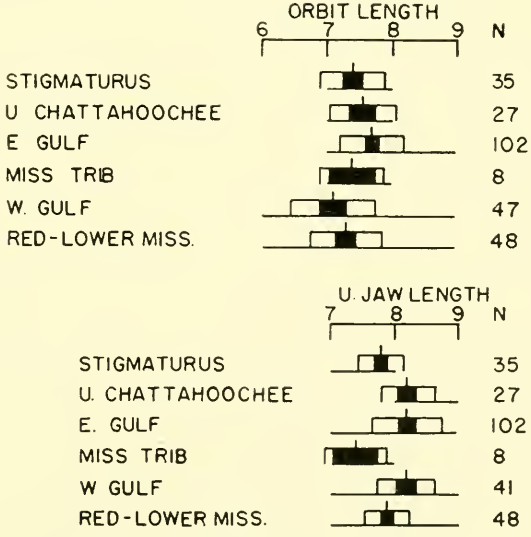


Figure 5. Graphic analysis of some proportional characters of *Notropis venustus*, expressed as percent of standard length.

TABLE 1.

FREQUENCY DISTRIBUTION OF SOME MERISTIC CHARACTERS IN SUBSPECIES, RACES, AND POPULATIONS OF *Notropis venustus*

Subspecies	Lateral Line Scales																		
	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	N	$\bar{x}$	SD	SE
venustus stigmaturus					1	5	21	43	33	11	12	8	4	1	1	170	42.1	1.67	.13
venustus cercostigma																			
E. Gulf Race				1	87	214	134	28	6	3	—	—	—	—	—	476	39.1	.96	.04
Upper Chattahoochee Race					2	28	26	12	2	—						70	39.8	.87	.10
venustus venustus																			
W. Gulf Race																			
W. Gulf population		9	62	112	46	5	—	—	—	—	—	—	—	—	—	234	36.8	.81	.05
Miss. trib. population			17	31	11	2	—	—	—	—	—	—	—	—	—	61	37.0	.79	.10
Red-Lower Miss. Race	8	20	71	77	24	6	—	—	—	—	—	—	—	—	—	206	36.5	1.04	.07

Subspecies	Pectoral Rays																		
	11	12	13	14	15	16	17	18	N	$\bar{x}$	SD	SE							
venustus stigmaturus			1	91	257	48	5	—	408	14.9	.65	.03							
venustus cercostigma																			
E. Gulf Race	1	1	17	217	558	196	39	1	1010	15.0	.77	.02							
Upper Chattahoochee Race				19	36	79	12	—	146	15.6	.82	.07							
venustus venustus																			
W. Gulf Race																			
W. Gulf population		2	30	152	235	13	1	—	433	14.6	.76	.03							
Miss. trib. population		—	12	75	50	9		—	146	14.4	.73	.06							
Red-Lower Miss. Race	—	5	61	198	129	12	1		409	14.2	.79	.04							

FREQUENCY DISTRIBUTION OF SOME PROPORTIONAL CHARACTERS, EXPRESSED AS PERCENT OF STANDARD LENGTH, IN SUBSPECIES, RACES, AND POPULATIONS OF *Notropis venustus*

Predorsal Length

Subspecies	50	51	52	53	54	55	56	N	$\bar{x}$	SD	SE
venustus stigmaturus			3	11	13	8	—	35	53.7	.92	.16
venustus cercostigma											
E. Gulf Race	—	1	12	27	33	21	5	102	53.8	1.11	.11
Upper Chattahoochee Race	—	—	6	8	7	1	1	26	53.5	1.14	.22
venustus venustus											
W. Gulf Race											
W. Gulf population	—	—	8	13	20	5	2	48	53.6	1.03	.15
Miss. trib. population	—	1	3	4	1	—	—	9	52.6	.88	.29
Red-Lower Miss. Race	1	3	7	15	11	6	2	48	52.3	2.01	.29

Postdorsal Length

	45	46	47	48	49	50	51	52	N	$\bar{x}$	SD	SE
venustus stigmaturus	1	5	13	12	4	—	—	—	35	47.4	.97	.16
venustus cercostigma												
E. Gulf Race	—	1	7	27	36	26	4	1	102	48.9	1.07	.11
Upper Chattahoochee Race	—	—	2	4	14	6	1	—	27	49.0	.92	.18
venustus venustus												
W. Gulf Race												
W. Gulf population	—	—	6	2	13	13	2	—	46	48.9	1.12	.16
Miss. trib. population	—	—	—	1	5	2	1	—	9	49.3	.87	.29
Red-Lower Miss. Race	—	—	1	7	16	15	6	3	48	49.6	1.14	.17

Head Length

	23	24	25	26	27	28	29	N	$\bar{x}$	SD	SE
venustus stigmaturus	4	8	19	3	1	—	—	35	24.7	.90	.15
venustus cercostigma											
E. Gulf Race	1	12	39	35	13	1	—	101	25.5	.93	.09
Upper Chattahoochee Race	—	7	12	8	—	—	—	27	25.0	.76	.15
venustus venustus											
W. Gulf Race											
W. Gulf population	1	8	14	20	2	2	—	47	25.1	1.03	.15
Miss. trib. population	—	1	6	2	—	—	—	9	25.1	.60	.20
Red-Lower Miss. Race	—	1	11	25	7	—	1	48	26.0	.85	.12

Body Depth

	18	19	20	21	22	23	24	25	26	27	28	29	30	31	N	$\bar{x}$	SD	SE
venustus stigmaturus	3	10	9	7	1	2	—	—	—	—	—	—	—	—	35	20.1	1.35	.23
venustus cercostigma																		
E. Gulf Race			6	10	8	16	25	21	10	4	1	—	—	—	101	23.7	1.87	.19
Upper Chattahoochee Race				3	7	6	6	5	—	—	—	—	—	—	27	23.1	.97	.19
venustus venustus																		
W. Gulf Race																		
W. Gulf population	—	—	—	—	1	6	8	13	12	1	1	—	—	—	45	25.0	1.33	.20
Miss. trib. population	—	—	—	—	—	—	4	2	1	—	—	—	—	—	7	24.6	.79	.30
Red Lower Miss. Race	—	—	—	—	—	—	1	1	13	8	7	9	5	1	48	27.4	.74	.11

TABLE 3.

FREQUENCY DISTRIBUTION OF SOME PROPORTIONAL CHARACTERS, EXPRESSED AS PERCENT OF STANDARD LENGTH, IN SUBSPECIES, RACES, AND POPULATIONS OF *Notropis venustus*

Subspecies or Race	Dorsal Origin				Lateral Line									
	11	12	13	14	15	16	17	18	19	20	N	$\bar{x}$	SD	SE
venustus stigmaturus	1	12	16	6	—	—	—	—	—	—	35	12.8	.77	.13
venustus cercostigma														
E. Gulf Race	1	—	11	23	38	23	5	1	—	—	102	14.9	1.15	.11
Upper Chattahoochee Race	—	—	1	10	10	3	—	—	—	—	27	14.4	.89	.17
venustus venustus														
W. Gulf Race														
W. Gulf population	—	—	—	6	15	18	6	—	—	—	45	15.5	.89	.13
Miss. trib. population	—	—	—	—	3	2	2	—	—	—	9	15.7	.87	.29
Red-Lower Miss. Race	—	—	—	1	1	10	13	13	9	1	48	17.4	1.25	.18

	Caudal Peduncle Depth								
	9	10	11	12	13	14	N	$\bar{x}$	SD	SE
venustus stigmaturus	12	20	3	—	—	—	35	9.7	.61	.10
venustus cercostigma										
E. Gulf Race	5	28	53	16	—	—	102	10.8	.77	.08
Upper Chattahoochee Race	—	11	12	4	—	—	27	10.5	.58	.11
venustus venustus										
W. Gulf Race										
W. Gulf population	—	2	19	19	6	1	47	11.7	.80	.12
Miss. trib. population	—	—	1	5	—	—	9	11.6	.43	.14
Red-Lower Miss. Race	—	—	3	23	18	4	48	12.5	.74	.11

	Orbit Length						
	6	7	8	9	N	$\bar{x}$	SD	SE
venustus stigmaturus	—	20	15	—	35	7.4	.50	.09
venustus cercostigma								
E. Gulf Race	—	29	71	2	102	7.7	.49	.05
Upper Chattahoochee Race	—	12	15	—	27	7.6	.51	.10
venustus venustus								
W. Gulf Race								
W. Gulf population	8	29	9	1	47	7.1	.67	.10
Miss. trib. population	—	5	3	—	8	7.4	.64	.23
Red-Lower Miss. Race	1	32	14	1	48	7.3	.55	.08

	Upper Jaw Length						
	7	8	9	N	$\bar{x}$	SD	SE
venustus stigmaturus	8	27	—	35	7.8	.33	.06
venustus cercostigma							
E. Gulf Race	8	68	26	102	8.2	.55	.06
Upper Chattahoochee Race	1	19	5	27	8.2	.40	.08
venustus venustus							
W. Gulf Race							
W. Gulf population	1	30	10	41	8.2	.48	.07
Miss. trib. population	5	3	—	8	7.4	.64	.23
Red-Lower Miss. Race	5	42	1	48	7.9	.35	.05

latter has a shorter postdorsal length, usually 47-51% of standard length, instead of 51-54%; a slightly smaller orbit, usually 7% instead of 8%; and a smaller mouth, upper jaw usually 7-8% instead of 9%.

The subspecies *N. v. venustus* is a deeper, larger-scaled form than any of the other subspecies. Comparisons are shown in Tables 1-3. Its lateral-line scale count seldom exceeds 38, whereas in the other subspecies this count is rarely less than 39. The body depth is usually 24-27% of standard length, compared to 21-25% in *N. v. cercostigma.* In other characters which reflect depth—dorsal origin to lateral line and caudal peduncle depth—*N. v. venustus* shows a difference which is less distinct, but similar. The eye tends to be smaller than in *N. v. cercostigma.* particularly in the Red-Lower Miss. Race, and there is a tendency for a higher proportion of specimens to have 13-2-11 predorsal circumferential scales and 13 pectoral rays.

Even the diagnostic caudal spot follows the proportional trend in *N. v. venustus* (figs. 6, 7). Although it is commonly quite similar to that in *N. v. cercostigma,* it tends to be shorter and wider, and in some specimens, or even whole collections, is almost square. The darkness of the spot is variable, for this is almost certainly dependent upon the turbidity of the water.

In those characters by which *N. v. venustus* differs from *N. v. cercostigma,* it is even more extreme in its separation from *N. v. stigmaturus* (see Tables 1-3).

Races.— Two races of *N. v. venustus* are recognizable. One of these is found in the Red River and the tributaries of the lower Mississippi River, and is hereafter referred to as the "Red-Lower Miss. Race". The other has its range divided by the first. It is found in western affluents of the Gulf of Mexico, from the Rio Grande to the Sabine (W. Gulf population) and again in the Ouachita, Black, and St. Francis Rivers in Missouri and Arkansas (Miss. trib. population). As a unit, it will be called the "Western Gulf Race".

The "Red-Lower Miss. Race" carries the tendencies of the subspecies to the extreme, as may be seen in Tables 1-3 and Figs. 1-5. The body depth averages over 27% of standard length, as compared to means of 24.6% and 25% in the two populations of the Western Gulf Race and 23.1% and 23.7% in the two races of *N. v. cercostigma.* The proportions dorsal origin to lateral line and caudal peduncle depth show similar differences. The tendency is strongest here to have 13-2-11 predorsal circumferential scales, although 15-2-11 remains the mode. Pectoral rays are modally 14 instead of 15, although this is true of the Miss. trib. population of the Western Gulf Race. Lateral-line scales show the greatest tendency to be few in number, and the caudal spot is commonly short and wide. This race is the form which Hildebrand and Towers (1928) described as *Notropis cooglei* from Greenwood, Mississippi.

The "Western Gulf Race" is less extreme than the Red-Lower Miss. Race in its distinctive characters, but is nevertheless quite different from *N. v. cercostigma,* as noted in the comparative diagnosis. Its

two geographically separated populations, between which the Red-Lower Miss. Race is interposed, are not significantly different in any of the characters analyzed (Tables 1-3; figs. 1-5).

Range (Map 1).—Tributaries to the Gulf of Mexico in Texas from the Rio Grande to the Sabine; Red River as far west as Oklahoma and Texas; Ouachita, Black, and St. Francis Rivers; Mississippi River tributaries from Mississippi and Louisiana to Missouri and Illinois.

Habitat.—The subspecies seems to prefer rather clear streams, and is apparently not extremely averse to warmth, or to temporary stagnation, which are common conditions in southwestern streams. Hubbs, Kuehne, and Ball (1953: 226) found it commonly in "clearer waters downstream from the spring sources". *N. lutrensis*, on the other hand,

Figure 6. Top. *Notropis v. venustus*. Female, 69.7 mm. USNM 166095. Hays Co., Texas. Guadalupe drainage. Middle. *N. v. venustus*. Nuptial male, 52.9 mm. CU 16297. West Feliciana Co., La. Lower Mississippi drainage. Bottom. Dorsal view of predorsal part of *N. v. cercostigma* showing breeding tubercle pattern. Photographs taken by Douglass M. Payne.

more frequently inhabited murky waters. Where the two were sympatric, *venustus* was "more abundant in swifter water".

Etymology.—The name *venustus* is an adjective derived from the name of the Roman goddess of love, Venus.

NOTROPIS VENUSTUS CERCOSTIGMA (COPE)
Eastern Blacktail Shiner

Cyprinella cercostigma—Cope, 1867: 157 (orig. descr., Pearl R. system, La.); Jordan and Copeland, 1876: 153; Jordan, 1878: 422; Jordan, 1928: 370 (Perdido Bay); Pratt, 1935: 75 (char., distr.); Schrenkeisen, 1938: 130 (char., distr.).

Minnilus cercostigma—Jordan and Gilbert, 1883: 193 (char., distr., syn.).

Notropis cercostigma—Jordan, 1885: 814; Jordan and Evermann, 1896a: 255 (distr., syn.); 1896b: 257, 275 (char., distr., syn.); Pratt, 1923: 79 (char., distr.); Jordan, 1928: 369 (distr.); Fowler, 1941: 4 (*coogle* believed synonymous); 1945: 363 (Miss. and La.).

Notropis venustus cercostigma—Gilbert, 1891: 158 (in part; Escambia system, Ala.); Kuhne, 1939 (Tenn., doubtful).

Erogala cercostigma—Jordan, Evermann and Clark, 1930: 130 (distr., syn.); Fowler, 1933: 59 (La., bait); Driver, 1942: 274 (char., distr.); 1950: 287 (char., distr.).

Photogenis eurystomus—Jordan, 1877b: 356 (orig. descr.; upper Chattahoochee system, Ga.); 1880: 239 (*leucopus* in syn.).

Cyprinella eurystoma—Jordan and Copeland, 1876: 153 (nom. nud.); Pratt 1935: 75 (char., distr.); Schrenkeisen, 1938: 131 (char., distr.).

Minnilus eurystomus—Jordan, 1877a: 80 (nom. nud.).

Codoma eurystoma—Jordan, 1878: 423; 1879: 111 (distr.); Jordan and Brayton, 1878: 20, 42.

Cliola eurystoma—Jordan and Gilbert, 1883: 180 (char., distr., syn.).

Notropis eurystomus—Jordan, 1885: 814; Jordan and Evermann, 1896a: 255 (distr., syn.); 1896b: 257, 276 (char., distr., syn.); Pratt, 1923: 79 (char., syn.); Jordan, 1928: 369 (distr.); Carr, 1937: 80 (Fla. key); Fowler, 1945: 234 (Ga).

Ergola eurystoma—Jordan, Evermann and Clark, 1930: 130 (distr., syn.).

Photogenis leucopus—Jordan and Brayton, 1878: 41 (orig. descr., upper Chattahoochee system, Ga.).

Luxilus leucopus—Jordan, 1878: 421.

Luxilus chickasawensis—Hay, 1881: 506 (orig. descr., Pascagoula system, Miss.).

Luxilus stigmaturus (misidentification)—Hay, 1883: 71, 74 (Pearl R. at Jackson, Miss.).

Notropis venustus stigmaturus (misidentification)—Bollman, 1887: 462 (Escambia system).

Notropis stigmaturus (misidentification)—Evermann and Kendall, 1900: 52 (Florida).

Types.—No trace has been found of any specimen from Cope's type series of *Cyprinella cercostigma*. The utility of choosing a neotype is not great enough at present to warrant such action. The

pharyngeal tooth count given by Cope (1867) of 2,4-4,2 is definitely aberrant, if correct. Types of several synonyms have been studied as follows.

Photogenis leucopus Jordan and Brayton. USNM 31124. Chattahoochee River at Shallow Ford, NW Gainesville, Jordan and Brayton. This has proved to be a composite collection (see Bailey and Gibbs, 1956). Two specimens of *Notropis callitaenia* Bailey and Gibbs have been recatalogued as USNM 163964. The two remaining specimens are of the Upper Chattahoochee Race of *Notropis venustus cercostigma.* One of these, a female, 77.8 mm, has been designated lectotype and retains USNM 31124. The other is recatalogued as USNM 163963. Another syntype is located in the Museum of Comparative Zoology and is MCZ 35935. This bears the notation that it was from USNM 31124. This nominal species has been considered synonymous with *Notropis eurystomus* (= *venustus cercostigma*) by Jordan and Gilbert (1883) and subsequent authors.

Luxilus chickasawensis Hay. USNM 27419. Chickasawha R., Miss., O. P. Hay. Taken in a major tributary of the Pascagoula, these specimens display no essential differences from *N. v. cercostigma.* Their synonymy has been recognized by Jordan (1886) and others. The lectotype here designated, a female, 76.6 mm, retains USNM 27419. Eight syntypes from the same collection have been recatalogued as USNM 163953.

Photogenis eurystomus Jordan. MCZ 24388. Now *Erogala eurystoma* Jordan. Chattahoochee Riv., Atl., Coll. by D. S. Jordan. Rec. 1879. This specimen, 68.3 mm in standard length, is hereby designated lectotype. The remaining specimens of Jordan's type series are apparently no longer extant.

Number of collections examined by river system.—Upper Chattahoochee Race: Upper Chattahoochee, 10. Eastern Gulf Race: Suwannee, 1; Apalachicola (Lower Chattahoochee, Flint), 26; Econfina, 2; Choctawhatchee, 13; Pensacola Bay (Black, Yellow), 13; Escambia, 16; Pascagoula, 14; Pearl, 7; Lake Pontchartrain drainage, 12.

Comparative diagnosis.—*Notropis callitaenia* and *N. leedsi* are the only species of *Cyprinella* known to occur in the range of *N. v. cercostigma.* The occurrence of intergrades between *N. v. cercostigma* and *N. v. stigmaturus* in the lower Alabama system may indicate the necessity for comparison with the three species of *Cyprinella* in the upper Alabama. Since this appears unnecessary at present, these species will be compared with *N. v. stigmaturus* only. Bailey and Gibbs (1956) have compared *N. v. cercostigma* with *callitaenia* and have shown that *callitaenia* has an inferior, rather then terminal or subterminal mouth; 13-2-11 predorsal circumferential scales, instead of 14- or 15-2-11; and an unpigmented lower jaw, which is pigmented at the symphysis in *venustus. N. callitaenia* often lacks pigment in the dorsal fin, whereas this is usually present and scattered on all membranes in *N. venustus,* and *callitaenia* possesses a chain of macromelanophores along the lower edge of the lachrymal bone from the

eye to the middle of the upper jaw. The larger basicaudal spot in *N. v. cercostigma* would ordinarily be diagnostic, but in the Chattahoochee and Flint Rivers, where *callitaenia* is found, this spot tends to be reduced. Still, it is larger, usually twice as long as wide, and distinct from the lateral stripe, while in *callitaenia*, the spot is not so large and often contrasts little with the dark lateral stripe. *N. callitaenia* often lacks a tooth in the minor row of one pharyngeal arch, whereas this is rare in *N. v. cercostigma*.

Notropis leedsi has been taken together with *N. v. cercostigma* only once, by D. C. Scott in the Alapaha River, a tributary to the Suwannee River, in Georgia. *N. leedsi* is a very different fish, in which the mouth is inferior, the scales are not narrowly outlined in black, the dorsal fin is most heavily pigmented in front, the membrane behind the leading rudimentary ray is usually notably dark, and the tooth count is 4-4. The tubercles of breeding males are in rows on the head, notal ridge, and lower caudal peduncle, and none are present on the chin rami. At the same time, the dorsal fin is greatly enlarged. These differences are trenchant and need no further elaboration.

Comparison has been made between *N. v. venustus* and *N. v. cercostigma* under the former subspecies. *N. v. venustus* is generally deeper, has usually 37 or less lateral-line scales, and commonly has a more square caudal spot. For comparison with *N. v. stigmaturus* and that subspecies, see Tables 1-3.

Races.—In addition to the typical race of *N. v. cercostigma*, which is widely distributed and will be called the "Eastern Gulf Race", there is a rather well-defined race in the upper Chattahoochee River above the rapids, which was recognized by Jordan (1877b) as *Photogenis eurystomus*. The most unusual difference between this and the remainder of *N. v. cercostigma* is the polymorphism in anal rays—eight and nine occurring in almost equal numbers in any collection (Table 6). The transition from collections which have almost entirely eight anal rays to those which have half-and-half is sudden. The Fall-zone rapids near Columbus are apparently an effective barrier, for all collections examined from above it have been different, with respect to anal rays, from those below. In addition, the pectoral rays are modally 16, although commonly 14 or 15, and the basicaudal spot is usually pale and narrow by comparison to the "Eastern Gulf Race". The latter phenomenon may be attributed to the turbidity of the water in which the fish exists. The same tendency is found, but less constantly, in specimens from the lower Chattahoochee (see fig. 7, bottom), Flint, and Apalachicola Rivers. Perhaps this indicates a genetic basis for caudal spot intensity, but as yet the proof is lacking.

Range (Map 1).—River systems of the eastern Gulf of Mexico from the Lake Pontchartrain drainage in Louisiana and Mississippi to the Suwannee system, Georgia (and probably Florida). Not yet collected in the Ochlockonee, but is probably there.

Habitat.—Clear, sandy-bottomed streams are the most common habitat. In the Chattahoochee the subspecies has been taken over

sandy bottom, but in extremely turbid waters as well as clear ones. The turbid condition is probably normal in the larger streams of the system, and may be a major factor in reducing the dimensions and intensity of the basicaudal spot.

Etymology.—The name *cercostigma* is a substantive derived from the Greek *kerkos*, tail, and *stigma*, spot, in allusion to the prominent basicaudal spot.

NOTROPIS VENUSTUS STIGMATURUS (JORDAN)
Slender Blacktail Shiner

Photogenis stigmaturus—Jordan, 1877b: 337 (orig. descr., Etowah R., Ga.).

Cyprinella stigmatura—Jordan and Copeland, 1876: 153 (nom. nud.); Pratt, 1935: 75 (char., distr.); Schrenkeisen, 1938: 130 (char., distr.).

Minnilus stigmaturus—Jordan, 1877a: 80 (nom. nud.).

Codoma stigmatura—Jordan, 1878: 410, 423; Jordan and Brayton, 1878: 20, 50, 52, 92 (char., distr., designated type of the new subgenus *Erogula*); Jordan, 1879: 111 (distr.).

Cliola stigmatura—Jordan and Gilbert, 1883: 182 (char., distr., syn.).

Notropis stigmaturus—Jordan, 1885: 814; Jordan and Evermann, 1896a: 255 (distr., syn.); 1896b: 257, 275 (char., distr., syn.); Fowler, 1910: 281 (variation); 1923a: 25 (paratypes in Acad. Nat. Sci. Phila.); 1923b: 20 (Coosa R., Ga.); Pratt, 1923: 79 (char., distr.).

Erogula stigmatura—Jordan, Evermann and Clark, 1930: 129 (distr., syn.); Fowler, 1935: 72 (Armuchee, Ga.).

Notropis venustus cercostigma (misidentification)—Gilbert, 1891: 154, 158 (in part; Alabama and Tombigbee systems, Ala.).

Types.—Photogenis stigmaturus Jordan. USNM 17891. Etowah River, Georgia, July, 1876, D. S. Jordan. The lectotype here designated, a male, 84.4 mm. retains USNM 17891. Ten syntypes bearing the same data have been recatalogued as USNM 163938. Another syntype, with essentially similar data, was found as USNM 20125. Eight further syntypes are located at the Philadelphia Academy and bear the catalogue numbers ANSP 19820-19827; and one at the Museum of Comparative Zoology is MCZ 24371.

Cyprinella calliura Jordan. USNM 6865. These specimens are recorded as collected in the Black Warrior River, Selma, Alabama, by Prof. Winchell. Selma is located in the drainage of the lower Alabama system and a good distance from the Black Warrior or any other part of the Tombigbee system. The specimens, therefore, are from an area of intergradation. The lectotype designated here, a male, 89.6 mm, retains USNM 6865; seven syntypes are now catalogued as USNM 163951.

Number of collections examined by river systems—Upper Alabama, 30; Tombigbee, 21.

Comparative diagnosis.—This subspecies is found in only the upper Alabama and Tombigbee rivers. In these systems, there are few species with which it could be confused, all of these belonging to the

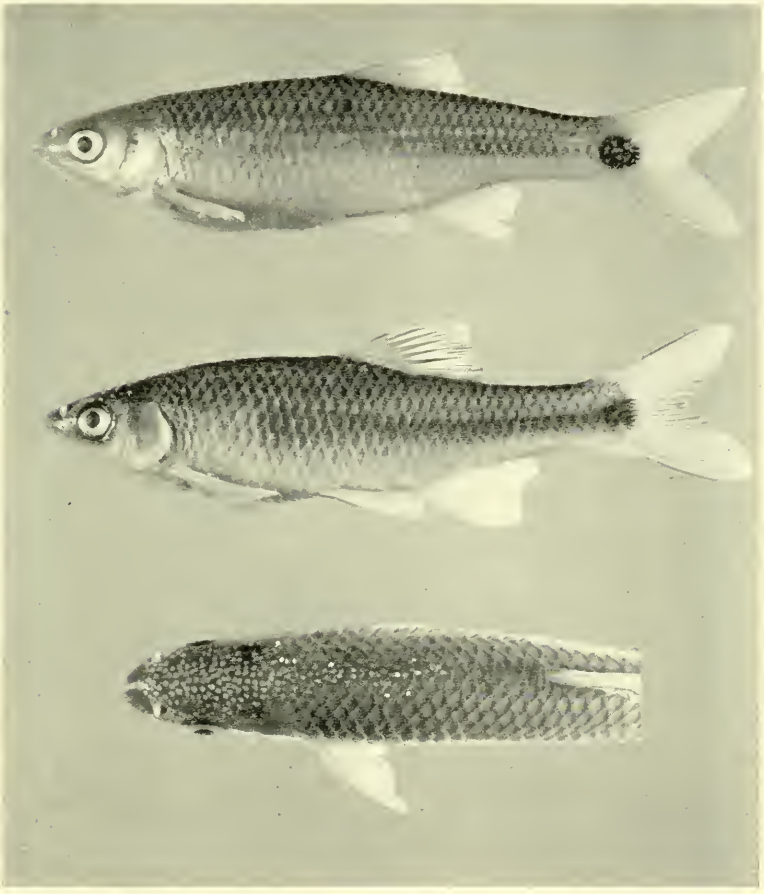


Figure 7. Top. *Notropis v. stigmaturus*. CU 17574. Gordon Co., Ga. Alabama drainage. Negative borrowed from E. C. Raney. Middle. *N. v. cercostigma*. Male, 66.4 mm. CU 16255. Wayne Co., Miss. Pascagoula drainage. Bottom. *N. v. cercostigma*. Female, 58.7 mm. CU 15836. Russell Co., Ala. Lower Chattahoochee drainage. Last two photographs taken by Douglass M. Payne. Notice the three degrees of development of the basicaudal spot.

subgenus *Cyprinella*. *Notropis callistius* and *trichroistius* have a more or less well-developed basicaudal spot. *Notropis caeruleus* lacks this.

N. caeruleus may be eliminated from consideration by its lack of the caudal spot, by its narrow, dark, blue to black lateral stripe which runs the entire length of the body, and its 11-2-9 predorsal circumferential scale count. The species is quite rare.

From *callistius*, *N. v. stigmaturus* may be differentiated by its terminal or subterminal, rather than inferior, mouth; by the narrowly

outlined, diamond-shaped scales margins which *callistius* lacks; by the concentration of melanophores in the last two or three dorsal membranes as compared to the scattered pigment in the fin of *callistius* (or a wide band in the middle of the fin in breeding males of the latter); and by the large, very dark basicaudal spot, which in *callistius* is lighter in its anterior half, is rather rounded posteriorly, and does not extend out onto the caudal rays. The species differ in many meristic counts. *N. callistius* usually has 38-40 lateral-line scales, rather than 40-43, 11-2-11 predorsal circumferential scales, instead of 15-2-11, and 7-2-7 caudal peduncle scales, instead of 7-2-5.

Breeding males of *callistius* have red dorsal and caudal fins (those of *N. v. stigmaturus* are yellow) and have large tubercles arranged in rows on the head and notal ridge, but none on the chin rami.

Notropis trichroistius comes nearest to being similar to *N. v. stigmaturus*, but here, too, the differences are trenchant. The lateral scales of *trichroistius*, except those just below the lateral line, are not narrowly edged in black, the pigment of the posterior dorsal rays is very dark, often jet black, and the caudal spot usually represents an expansion posterior to a constriction of the lateral stripe (i.e., continuous with the lateral stripe). Meristically there is much overlap, but *trichroistius* has predominantly 39-41 lateral-line scales, rather than 40-43, and usually 13-2-11 predorsal circumferential scales, instead of 15-2-11. Dorsal origin to lateral line in *trichroistius* is usually 14-16% of standard length, instead of 12-14%, the orbit 8-9%, instead of 7-8%, the upper jaw 9-10%, instead of 7-8%.

Breeding males of *trichroistius* have brilliant orange fins, and large tubercles in rows on the head, notal ridge, and lower caudal peduncle.

There is apparent intergradation between *N. v. stigmaturus* and *N. v. cercostigma* in the lower Alabama and, presumably, the Mobile rivers. These presumed intergrades have been analyzed meristically, but not proportionally. The comparisons between subspecies do not take cognizance of these intergrades.

N. v. stigmaturus is in every respect a long, slender fish, the extreme for the species *venustus*. The postdorsal length is slightly less than in *N. v. cercostigma*, indicating a less-declivitous profile. The head averages the shortest of all the populations. Body depth is usually 19-22% of standard length, compared to 21-26% in *cercostigma*, dorsal origin to lateral line 12-14%, rather than 13-16%, and caudal peduncle depth averages less than any other. Lateral-line scales are usually 40-43, but range as high as 48.

N. v. stigmaturus alone, of all the subspecies of *venustus*, has the pigmentation of the last two dorsal membranes quite prominent, and usually lacks melanophores in the anterior three membranes. The basicaudal spot is the best developed, but this is difficult to measure and is an average phenomenon, many *N. v. cercostigma* approaching closely.

Tables 1-3 and Figs. 1-5 give comparisons with other subspecies and races.

Range (Map 1).—Upper Alabama and Tombigbee systems in Mississippi, Alabama, and Georgia.

Habitat.—Clear, cool streams, commonly with gravel to pebble bottoms. The subspecies has been taken in turbid water, but this may be presumed to have been a temporary condition.

Etymology.—The name *stigmaturus* is an adjective derived from the Greek *stigma*, spot, and *oura*, tail, in reference to the prominent tail spot.

NOTROPIS VENUSTUS: CERCOSTIGMA X STIGMATURUS Intergrades

Cyprinella calliura—Jordan, 1877b: 61 (orig. descr., locality partly in error. Selma, Ala. is in Alabama R. drainage).

Luxilus calliurus—Jordan, 1878: 421; 1879: 110 (distr.).

Cliola calliura—Jordan and Gilbert, 1883: 178 (char., distr., syn.).

Notropis venustus cercostigma—Gilbert, 1891: 154 (in part; Alabama system, Ala.).

Discussion.—Principally on the basis of intermediacy in lateral-line scale counts, specimens from the lower Alabama system are considered intergrades. No collections of *Notropis venustus* have been seen from the lower Tombigbee, the lowest portion of the Alabama, or the Mobile River. Future collecting in this area may turn up proof either for or against the present contention.

The status of the types of *Cyprinella calliura* has been discussed with the types of *N. v. stigmaturus*.

Number of collections examined.—Lower Alabama system, Dallas, Lowndes, and Macon cos., Ala., 17.

Infraracial Variation

The variation among river systems which is obvious in Tables 4-6 may be attributed to sampling error or to slight genetic drift, for no consistent pattern is shown. Perhaps the effects of slightly different environments have evoked phenotypic responses, but much more work will have to be done on this subject before the answer is forthcoming.

Dispersal and Speciation

Notropis venustus seems closest related to *N. spilopterus* on a morphological basis. Both species have yellow fins in breeding males, have a similar tubercle pattern, and display a tendency toward reduction in pigmentation of the dorsal fin. Both have similar body forms, although this could easily be due to convergence. The basic pigmentation patterns are quite alike. Although *spilopterus* usually lacks a caudal spot, specimens have been seen in which a definite spot was present. Both have a rather prominent and wide lateral stripe. The dark side patch of breeding males of *N. venustus* has been noticed on occasion in *spilopterus*. This postulated relationship may not be extremely close, but it probably represents the nearest observable approach.

TABLE 4.

FREQUENCY DISTRIBUTION OF LATERAL-LINE SCALES OF *Notropis venustus* BY RIVER SYSTEMS

River System	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	N	$\bar{x}$	SD	SE
Suwannee	—	—	—	—	2	4	1	—	—	—	—	—	—	—	—	7	38.9	.69	.26
Apalachicola	—	—	—	—	—	5	13	1	—	—	—	—	—	—	—	19	39.8	.54	.12
Flint	—	—	—	1	11	22	4	1	—	—	—	—	—	—	—	39	38.8	.76	.12
Lower Chattahoochee	—	—	—	—	18	49	19	2	1	—	—	—	—	—	—	89	39.1	.78	.08
Upper Chattahoochee	—	—	—	—	2	28	26	12	2	—	—	—	—	—	—	70	39.8	.87	.10
Econfina	—	—	—	—	—	5	9	2	1	1	—	—	—	—	—	18	40.1	1.08	.25
Choctawhatchee	—	—	—	—	9	22	8	—	—	—	—	—	—	—	—	39	39.0	.67	.11
Pensacola Bay	—	—	—	—	4	37	35	4	—	—	—	—	—	—	—	80	39.5	.68	.08
Lower Alabama	—	—	—	—	1	5	11	5	2	1	—	—	—	—	—	25	40.2	1.12	.22
Tombigbee	—	—	—	—	1	4	16	21	10	11	1	5	1	—	1	71	41.6	1.80	.22
Upper Alabama	—	—	—	—	—	1	5	22	23	30	11	3	3	1	—	99	42.4	1.50	.15
Pascagoula	—	—	—	—	16	27	9	5	—	—	—	—	—	—	—	57	39.1	.89	.12
Pearl	—	—	—	2	15	10	5	2	—	—	—	—	—	—	—	34	38.7	1.00	.17
Pontchartrain	—	—	—	1	11	28	20	6	2	1	—	—	—	—	—	69	39.4	1.09	.13
Lower Mississippi	7	13	41	67	21	6	—	—	—	—	—	—	—	—	—	155	36.7	1.09	.09
Red	1	7	30	10	3	—	—	—	—	—	—	—	—	—	—	51	36.1	.80	.11
Ouachita	—	—	—	4	1	—	—	—	—	—	—	—	—	—	—	5	37.2	.45	.20
White	—	—	7	26	6	2	—	—	—	—	—	—	—	—	—	41	37.1	.72	.11
St. Francis	—	—	10	5	8	—	—	—	—	—	—	—	—	—	—	23	36.9	.79	.17
Sabine Lake	—	—	5	16	6	—	—	—	—	—	—	—	—	—	—	27	37.0	.65	.13
Galveston Bay	—	1	10	24	14	2	—	—	—	—	—	—	—	—	—	51	37.1	.84	.12
Brazos	—	5	29	46	11	—	—	—	—	—	—	—	—	—	—	91	36.7	.76	.08
Colorado	—	1	16	12	6	3	—	—	—	—	—	—	—	—	—	38	36.8	1.00	.16
Guadalupe	—	1	1	5	3	—	—	—	—	—	—	—	—	—	—	10	37.0	.94	.30
Nueces	—	1	1	8	5	—	—	—	—	—	—	—	—	—	—	15	37.1	.83	.22
Rio Grande	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	2	37.5	—	—

TABLE 5.
FREQUENCY DISTRIBUTION OF PECTORAL RAY COUNTS OF *Notropis venustus* BY RIVER SYSTEMS

River System	11	12	13	14	15	16	17	18	N	$\bar{x}$	SD	SE
Suwannee	—	—	—	4	7	3	—	—	14	14.9	.73	.20
Apalachicola	—	—	—	4	16	18	—	—	38	15.4	.68	.11
Flint	—	—	2	20	43	16	3	—	84	15.0	.82	.09
Lower Chattahoochee	—	1	1	38	94	38	4	1	177	15.0	.80	.06
Upper Chattahoochee	—	—	—	19	36	79	12	—	146	15.6	.82	.07
Econfina	—	—	—	6	31	3	—	—	40	14.9	.47	.07
Choctawhatchee	—	—	1	17	62	27	3	—	110	15.1	.73	.07
Pensacola Bay	—	—	1	29	103	30	3	—	166	15.0	.67	.05
Lower Alabama	—	—	4	14	22	10	—	—	50	14.8	.87	.12
Tombigbee	—	—	1	30	99	19	3	—	152	15.0	.65	.05
Upper Alabama	—	—	3	64	148	29	2	—	246	14.9	.66	.04
Pascagoula	1	—	7	31	69	16	2	—	126	14.8	.86	.08
Pearl	—	—	—	24	32	10	—	—	66	14.8	.69	.09
Pontchartrain	—	—	2	30	79	25	4	—	140	15.0	.75	.06
Lower Mississippi	—	5	39	147	108	9	1	—	309	14.3	.79	.04
Red	—	—	25	51	21	3	—	—	100	14.0	.77	.08
Ouachita	—	—	—	5	3	2	—	—	10	14.7	.82	.26
White	—	—	6	44	34	4	—	—	88	14.4	1.27	.14
St. Francis	—	—	6	26	13	3	—	—	48	14.3	.77	.11
Sabine Lake	—	—	1	16	40	4	—	—	61	14.8	.59	.08
Galveston Bay	—	—	—	41	50	13	—	—	104	14.7	.67	.07
Brazos	—	1	15	62	88	15	1	—	182	14.6	.80	.06
Colorado	—	—	9	32	36	7	—	—	84	14.5	.80	.09
Guadalupe	—	—	2	9	9	4	—	—	24	14.6	.88	.18
Nueces	—	1	3	22	8	—	—	—	34	14.1	.67	.11
Rio Grande	—	—	—	—	4	—	—	—	4	15.0	—	—

TABLE 6.
FREQUENCY DISTRIBUTION OF SOME MERISTIC CHARACTERS OF *Notropis venustus* BY RIVER SYSTEMS

River System	Anal Rays				Pred. Circumf. Scales above LL					
	7	8	9	N	13	14	15	16	17	N
Suwannee	—	7	—	7	—	—	6	—	1	7
Apalachicola	—	17	2	19	—	4	11	1	3	19
Flint	—	38	4	42	2	5	31	1	1	39
Lower Chattahoochee	—	80	9	89	18	7	61	3	—	89
Upper Chattahoochee	—	38	44	82	7	9	56	1	—	73
Econfina	—	20	—	20	—	—	16	1	1	18
Choctawhatchee	—	53	3	56	2	4	31	—	4	41
Pensacola Bay	—	79	4	83	5	8	60	4	2	79
Lower Alabama	—	23	2	25	2	4	16	2	1	25
Tombigbee	3	71	3	77	—	4	57	7	2	70
Upper Alabama	—	116	8	124	2	4	75	5	14	100
Pascagoula	—	62	1	63	6	9	37	3	3	58
Pearl	—	32	2	34	1	1	29	1	2	34
Pontchartrain	—	67	3	70	6	3	54	1	5	69
Lower Mississippi	1	146	9	156	56	23	73	2	1	155
Red	1	50	—	51	16	7	27	1	—	51
Ouachita	—	4	1	5	1	—	4	—	—	5
White	—	42	2	44	17	5	19	—	—	41
St. Francis	—	22	2	24	8	4	11	—	—	23
Sabine Lake	—	28	3	31	3	—	23	—	1	27
Galveston Bay	—	50	2	52	6	3	41	—	2	52
Brazos	1	86	4	91	30	11	45	2	2	90
Colorado	—	39	3	42	10	4	4		—	38
Guadalupe	—	7	3	10	5	1	4			10
Nueces	—	16	1	17	8	1	7			16
Rio Grande	—	2	—	2	—	—	2			2

The following paragraphs must be taken in the proper perspective. They represent conjecture as to the possible sequence of events in the history of the species, the evidence for which is little more than the present pattern of distribution of the subspecies and races. Admittedly alternative explanations might be possible.

From the present distribution of the species *venustus*, it seems logical to assume a center of origin somewhere in the Gulf coast drainages. With the abundance of bays and estuaries, the distribution to the east and west is not difficult to explain. Jordan (1928: 370) reports seeing *Cyprinella cercostigma* (= *N. v. cercostigma*) in Perdido Bay, along with a marine goby and a sea eel; and Bailey, Winn and Smith (1954: 160) have recorded it in the tidal portion of the Escambia River, where the salinity was recorded as 1.8‰ at the surface and 22.6 at the bottom. The species, then, can tolerate brackish water, through which it has dispersed.

The precise sequence of origin of the subspecies (presuming their genetic validity) is indefinite. Gene flow between *N. v. venustus* and *N. v. cercostigma* must have been rather long restricted, for when the Mississippi River, which presently demarcates their respective ranges, did not extend for its present length, there was an embayment in which coastal plain sediments were laid down as far north as southern Illinois and up the Red River valley to Texas and Oklahoma. Which of the two subspecies was the ancestral form is uncertain.

Following the differentiation of the two subspecies, *N. v. venustus* was apparently able to disperse up the west side of the Mississippi and become established in its western river systems. At some time during the repeated inundations of the Mississippi basin, a stock presumably became at least partially isolated in the Red River and differentiated to a racial level. The Red River is postulated as the place of origin because it seems more likely to have been suitable habitat and at the same time fairly well isolated during the Pleistocene than do the tributaries of the lower Mississippi, which would have been non-existent at the same time and seem to offer poor opportunity for isolation and later dispersal. The resultant deep-bodied form has since occupied most of the lower Mississippi tributaries and is interposed between two segments of the Western Gulf Race. The isolated populations of the "Western Gulf Race" in the Ouachita, Black, and St. Francis rivers have apparently not been swamped because of their habitat in the Ozark Plateau and the Ouachita Mountains, to which the "Red-Lower Miss. Race" is less well-adapted.

Of the affluents of the eastern Gulf, only two systems, the Alabama and the Chattahoochee, reach to any extent out of the Coastal Plain. In the upper portions of each of these systems a distinctive form has evolved. The Fall Zone, therefore, apparently acts as a partial barrier. The upper "Chattahoochee Race" of *N. v. cercostigma* is differentiated on a fairly low level, but, as has been pointed out, the presence of an almost equal number of specimens having eight and nine anal rays is noteworthy. The Alabama River is well-known as the habitat of

a number of distinctive forms. There are three species of *Cyprinella*, in addition to *N. r. stigmaturus*, which are found only there or also in the Tombigbee. Probably the high water levels of the Pleistocene were directly responsible for the isolation and speciation of *stigmaturus*.

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Abstract

Notropis venustus is redescribed and its three subspecies are characterized and their synonymies given. *N. v. venustus* consists of two races, one in the affluents of the Gulf of Mexico west of the Mississippi to the Rio Grande and in certain Ozarkian drainages, the other interposed in the Red River and tributaries to the lower Mississippi. *N. v. cercostigma* has a typical race occupying Gulf of Mexico drainages east of the Mississippi to the Suwannee and another restricted to the upper Chattahoochee River above the Fall Zone. *N. v. stigmaturus* is found only in the Alabama and Tombigbee rivers. Apparent intergrades, *N. v.* : *cercostigma* x *stigmaturus* are found in the lower part of the Alabama system.

The closest relative of *N. venustus* appears to be *N. spilopterus*. *N. venustus* is believed to have originated somewhere in the Gulf of Mexico tributary system, and to have dispersed through the more or less brackish estuaries and embayments. Where populations have reached above a zone of rapids, differentiation has been accelerated, giving rise to *N. v. stigmaturus* and the Upper Chattahoochee Race of *N. v. cercostigma*.