Bulletin
Alabama Museum of Natural History

may 15, 1980

number five

Notropis candidus, a new cyprinid fish from the Mobile Bay basin, and a review of the nomenclatural history of *Notropis shumardi* (Girard)

Royal D. Suttkus
Museum of Natural History, Tulane University
Belle Chasse, Louisiana 70037

Noturus stanauli, a new madtom catfish (Ictaluridae) from the Clinch and Duck Rivers, Tennessee

David A. Etnier
Department of Zoology, University of Tennessee
Knoxville, Tenn. 37916

Robert E. Jenkins
Department of Biology, Roanoke College
Salem, Va. 24153

BULLETIN ALABAMA MUSEUM NATURAL HISTORY is published by the Alabama Museum of Natural History, The University of Alabama. The BULLETIN is devoted primarily to the subjects of Anthropology, Archaeology, Botany, Geology and Zoology of the Southeast. The BULLETIN will appear irregularly in consecutively numbered issues. Manuscripts will be evaluated by the editor and an editorial committee selected for each paper.

Authors are requested to conform with the CBE Style Manual, 3rd edition, 1972, published by the American Institute of Biological Science, Washington, D.C. An abstract not exceeding three percent of the original text or four pages must accompany the manuscript.

For information and policy on exchanges, write to the Librarian, The University of Alabama, Box S, University, Al. 35486.

Numbers may be purchased individually; standing orders are accepted. Remittances should be accompanied by orders and made payable to The University of Alabama.

Communication concerning manuscripts, editorial policy, and orders for individual numbers should be addressed to the editor:

Herbert Boschung
Alabama Museum of Natural History
The University of Alabama
Box 5897
University, Alabama 35486

When citing this publication, authors are requested to use the following abbreviation: Bull. Alabama Mus. Nat. Hist.

Price this number: $2.50

Notropis candidus, a new cyprinid fish from the Mobile Bay basin, and a review of the nomenclatural history of *Notropis shumardi* (Girard)

Royal D. Suttkus
Museum of Natural History, Tulane University Belle Chasse, Louisiana 70037

ABSTRACT: Suttkus, Royal D. 1980. *Notropis candidus*, a new cyprinid fish from the Mobile Bay basin, and a review of the nomenclatural history of *Notropis shumardi* (Girard). Bulletin Alabama Museum of Natural History, Number 5:1-15, 11 tables, 5 figs. A new species of shiner, *Notropis candidus*, is described. It is an endemic in the Mobile Bay basin and is believed to be a close relative of *N. shumardi*. Both species have 2,4-4,2 pharyngeal teeth and typically nine pelvic fin rays. The two species differ in pigmentation, proportions and in a number of meristic characters. *Notropis candidus* usually has eight anal rays, *N. shumardi* typically nine; *candidus* has lower modal number of vertebrae, lateral line scales and body circumference scale rows and higher modal number of gill rakers than lower Mississippi River samples of *shumardi*. *Notropis candidus* attains a larger size, has a slimmer body, larger eye, and different chin pigmentation than *shumardi*. Data on reproduction, sex ratio and tuberculation are presented.

The nomenclatural history of *Notropis shumardi* is reviewed. Various discrepancies are disclosed; however, these are considered to be insufficient to warrant a change in trivial name usage.

Editorial Committee for this paper:

Dr. Glenn H. Clemmer, Mississippi State University, Mississippi State, MS 39762
Dr. Carter Gilbert, Florida State Museum (University of Florida), Gainesville, FL 32601
Dr. Franklin F. Snelson, Jr., Florida Technological University, Orlando, FL 32816

Tulane University Meseum of Natural History Contribution No. 17.

Introduction

The synonymy, characters and distribution of the silverband shiner, *Notropis shumardi*, were reviewed by Gilbert and Bailey (1962). They showed that the name *(illecebrosus)* previously employed for this species could no longer be used because of a nomenclatural decision made many years earlier. They recognized three disjunct geographical areas as being included in the range of *Notropis shumardi:* Mobile Bay basin; Mississippi Valley; and the Brazos, Colorado, and San Bernard river drainages of Texas. The latter population had previously been regarded as a distinct species *(brazosensis)*, but was synonymized by Gilbert and Bailey (1962). Although Gilbert and Bailey recognized differences in the Mobile Bay population, the few specimens (15) available at the time did not permit a complete assessment of the problem; they considered the observed differences to most likely result from allometry.

Recent collections of large numbers of specimens from the Mobile Bay basin now permit reevaluation of this population, which is here regarded as a distinct species and is described as new. *Notropis shumardi* was not restudied throughout its range, but data on additional samples are presented for comparative purposes.

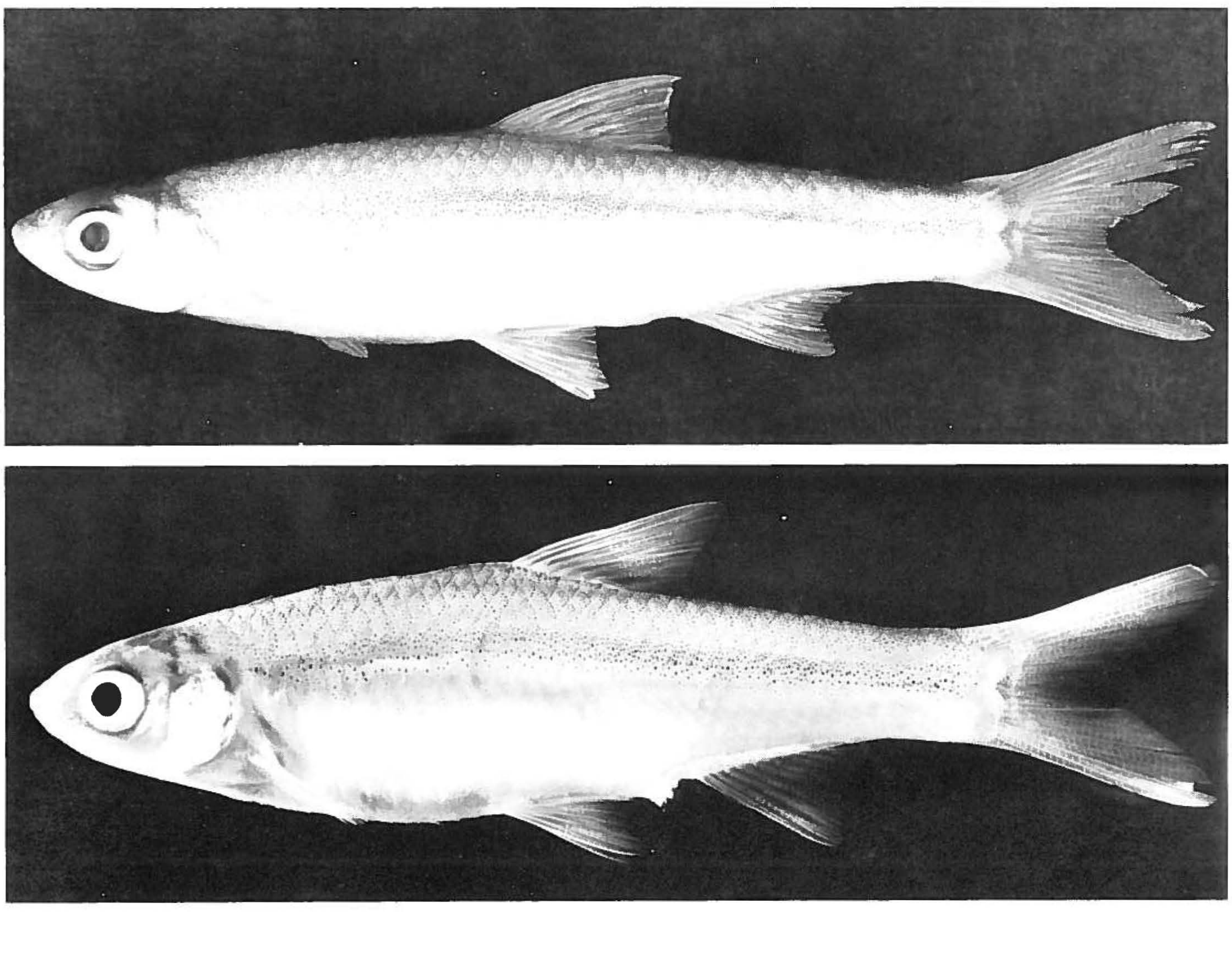
Acknowledgments

During the last ten years John H. Caruso, Robert C. Cashner, Glenn H. Clemmer, John V. Conner, Gerald E. Gunning and Bruce A. Thompson have given valuable collecting assistance for which I am most grateful. The photographs by Jeanne Suttkus are also much appreciated. The drawings were done by Pamela M. Caruso.

I particularly wish to thank Dr. Ernest A. Lachner, National Museum of Natural History, for many stimulating discussions on cyprinid systematics, ecology and nomenclature. His counsel has proved invaluable in the preparation of this paper. Also I wish to thank Drs. Reeve M. Bailey and Carter R. Gilbert for opinions regarding *Notropis shumardi.* In addition, I am grateful to Reeve M. Bailey for suggesting the trivial name for the new species.

The following persons facilitated loans and helped to ascertain the status of syntypic material of *Alburnops illecebrosus:* Reeve M. Bailey, James E. Böhlke, Herbert Boschung, Glenn H. Clemmer, Neil H. Douglas, Ernest A. Lachner, Karl F. Liem, and Loren P. Woods.

Fig. 1. (upper) *Notropis candidus* (TU 76253) paratype, 78.0 mm SL. (lower) *Notropis shumardi* (TU 96418) 58.4 mm SL.



Materials and Methods

Specimens examined were primarily those housed in the Tulane University Museum of Natural History (TU). Other specimens were utilized, such as type specimens at the National Museum of Natural History (USNM) and some series from Northeast Louisiana University (NLU), Mississippi State University (MSU), University of Alabama Ichthyological Collection (UAIC) and University of Tennessee (UT). A number of series that were used and cataloged in the Tulane collection were donated by Glenn H. Clemmer, John V. Conner and R. D. Nester.

Counts and measurements follow those described by Hubbs and Lagler (1958). Measurements were taken with a dial caliper and were recorded to the nearest tenth of a millimeter. Length measurements are in standard lengths (SL). Vertebral counts include four elements in the Weberian complex and the urostylar vertebra.

Notropis candidus, a new species
Silverside Shiner
Figures 1 and 2

Notropis shumardi (misidentification in part).—Gilbert and Bailey, 1962:807-819 (reference to Alabama distribution, including map).—Moore, 1968:81 (reference to Alabama distribution.—Smith-Vaniz, 1969:49 (Alabama distribution).—Pflieger, 1971:344 (reference to Alabama distribution).—Miller and Robison, 1973;100 (reference to Alabama distribution).—Douglas, 1974:150 (reference to Mobile Bay population).—Pflieger, 1975:144 (map).

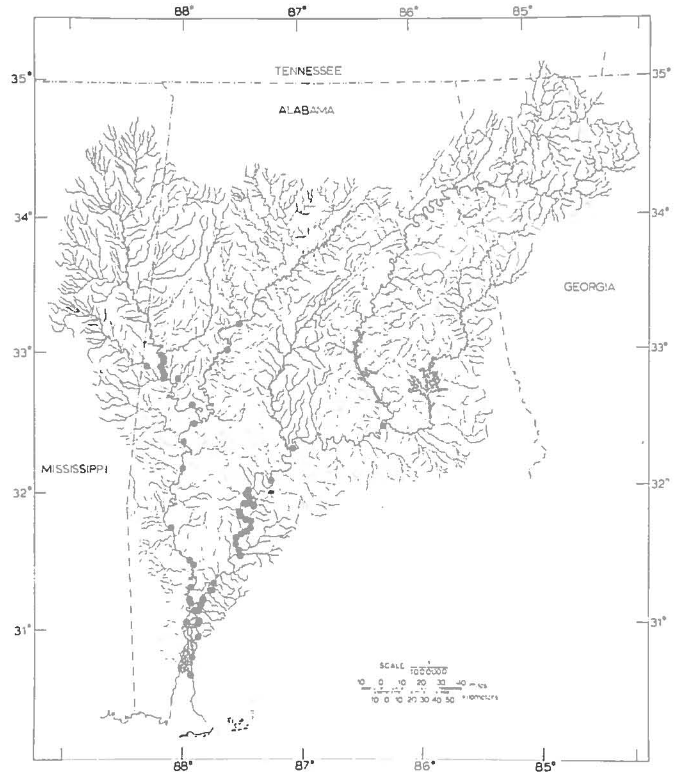


Fig. 2. Distribution of collection sites of *Notropis candidus.* Star symbol indicates type-locality.

HOLOTYPE.—TU 103415, an adult female, 80.1 mm SL, was collected from the Alabama River, along the right (west) bank at Yellow Jacket Bar, River Mile 129.8 (U.S. Corps of Engineers Navigation Chart, 1958), 2 kilometers downriver from Holly Ferry crossing or 20 kilometers east of Pine Hill, Wilcox County, Alabama, on 26 June 1969, at 0015 to 0110 hours, (RDS 4566) by R. D. Suttkus, Gerald E. Gunning and Robert C. Cashner.

PARATYPES.—TU 57763 (84), 55.8-92.4 mm SL were taken with the holotype. *Paratopotypes:* TU 40313 (25), 54.0-85.3 mm SL, were taken on 7 April 1966 by Suttkus and Gunning; TU 40928 (13), 55.9-75.7 mm SL, 28 June 1966, Suttkus, Gunning and Clemmer; TU 41414 (35), 55.6-83.1 mm SL, 1 July 1966, Suttkus and Environmental Biology Class; TU 52832 (37), 58.8-74.9 mm SL, 29 June 1968, Suttkus and Gunning; and TU 76253 (203), 26.0-80.2 mm SL, 16 March 1972, Suttkus and Thompson. Other paratypes obtained from Alabama River at Evans Lower Bar along right (west) bank, River Mile 133, Wilcox County, Alabama are TU 76231 (132), 29.1-83.0 mm SL, 16 March 1972, Suttkus and Thompson; 347 specimens, 6 December 1972, Suttkus and Cashner. They are distributed as follows: TU 80311(250), 35.7-82.1 mm SL; University of Michigan, Museum of Zoology, UMMZ 200217(20), 49.4-80.1 mm SL; University of Florida, FSM 24181(20), 48.2-72.8 mm SL; University of Alabama, UAIC 5495.01(21), 52.6-75.3 mm SL; and National Museum of Natural History, USNM 217389(36), 50.6-79.5 mm SL. TU 86774(212)28.8-85.0 mm SL, 19 March 1974, Suttkus and Thompson; and TU 96458(139), 28.1-74.0 mm SL, 18 December 1975, Suttkus and Gunning. Other paratypes obtained from Alabama River at Evans Upper Bar, along left (east) bank, River Mile 135.8 Wilcox Co., Alabama are TU 40903(26), 51.9-71.4 mm SL, 28 June 1966, Suttkus, Gunning, Clemmer; TU 47903(109), 47.2-74.3 mm SL, 26 September 1967, Gunning and Armand Kuris; and TU 52854(23), 53.4-70.3 mm SL, 29 June 1968, Suttkus and Gunning. Other specimens examined are listed under Material Examined.

DIAGNOSIS.—A moderately slim shiner up to 92.4 mm in standard length; typically eight anal rays; usually 9 pelvic rays; usually 37 vertebrae; usually 24 body circumference scale rows, often 23; usually nine gill rakers on first arch, often eight; head length greater than body depth, even in large gravid females; orbit large; fleshy interorbital distance narrow.

DESCRIPTION AND COMPARISONS.—*Notropis candidus* is similar to *Notropis shumardi* in a number of proportions (Tables 1 and 2) but differs primarily in size of orbit (Fig. 3), interorbital width, depth of body, and width of body. These various proportions were determined for a series of specimens of graded sizes. Ten different proportional relationships were determined for 211 specimens of *N. candidus* and 190 specimens of *N. shumardi* (Table 2).

Although the depth of body of *N. candidus* tends to increase with increase in body length, the body depth does not exceed the head length of respective individuals (Table 2, Fig. 4). In contrast, *N. shumardi* does change body proportions, such as depth of body, very markedly. Some specimens in the relatively small size class (25.0-34.9 mm

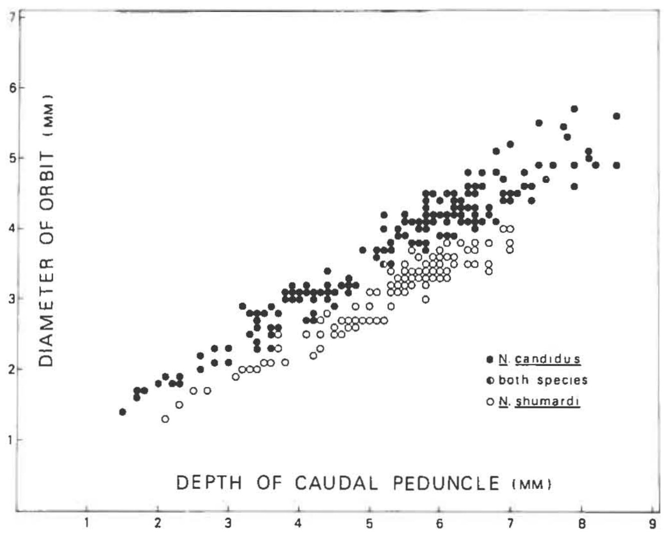


Fig. 3. Relation of orbit diameter (horizontal) to depth of caudal peduncle in *Notropis candidus* and *Notropis shumardi.*

SL) have greater body depth than head length. Moreover, the successively larger size groups have a higher percentage of individuals with deep bodies, and the largest two size groups (Table 2) of *N. shumardi* have a mean value that represents a body depth greater than the head length. No emaciated specimens of either species were used for the proportional measurements. Many specimens of the larger sizes of both species were gravid females or nuptial males.

Notropis candidus is a moderately slim minnow with a somewhat compressed body; however, its body is not as compressed as that of *N. shumardi.* The snout of *N. candidus* is more pointed than that of *N. shumardi.* The dorsal origin is over or slightly behind the insertion of the pelvics. Although the dorsal fin and pelvic fins are closer to the snout than to the caudal base in both species, these fins are farther forward in *Notropis candidus* (Table 1). The length of the depressed dorsal and anal fins, expressed in thousandths of standard length, show very little overlap between the two species (Table 1). These fins are longer in proportion to body length in *N. shumardi* than in *N. candidus.* The pectoral and pelvic fin lengths show more overlap between the two species. These two fins are also longer in proportion to body length in *N. shumardi* than in *N. candidus.* There is no overlap between the two species (ten specimens of each) with regards to width of fleshy interorbital distance and depth of caudal peduncle (Table 1). The interorbital width is narrower and the caudal peduncle is less deep in the silverside shiner, *N. candidus.*

Notropis candidus is a larger form than *N. shumardi.* Gilbert and Bailey (1962) stated that few individuals were more than 70 mm. Presumably they were referring to the large specimens from the Alabama River because the largest *N. shumardi* they had (their table 3) available from the Mississippi basin was 69.5 mm, and largest from Texas and upper Red River was 67.5 mm SL. I examined thirty series (1667 specimens) of *N. candidus* for large specimens. There are two specimens over 90 mm, 21 specimens greater than 80 mm SL and 125 specimens greater than 70 mm SL.

Scale, fin-ray, gill raker and vertebral counts are presented in Tables 3-9. Other meristic counts were made in addition to those presented in the tables. The number of specimens utilized varied among the different counts because of mutilations such as missing scales from the caudal peduncle. The predorsal scale row counts between origin of dorsal fin and opercle and rows of scales around the caudal peduncle are similar for *N. candidus* and *N. shumardi.* The 859 specimens of *N. candidus* have the following predorsal counts: 14 (6); 15 (196); 16 (605); 17 (51); and 18 (1) and the 108 *N. shumardi* have 14 (1); 15 (22); 16 (64); 17 (18) and 18 (3) predorsal counts. The 855 specimens of *N. candidus* have the following caudal peduncle scale row counts: 12 (818); 13 (23) and 14 (14) and the 103 specimens of *N. shumardi* have 12 (71); 13 (20); 14 (11) and 16 (1) caudal peduncle scales.

The number of dorsal fin rays were counted with the following results: *N. candidus* 7 (2), 8 (864), 9 (3), 10 (1); *N. shumardi* 8 (176), 9 (6). Counts of the principal caudal rays are as follows: *N. candidus* 16 (1), 17 (2), 18 (10), 19 (836), 20 (18), 21 (3); *N. shumardi* 18 (3), 19 (179), 20 (1).

The basic pharyngeal tooth number (2,4-4,2) is the same for both *N. candidus* and *N. shumardi.* Examination of 50 specimens of *N. candidus* shows the following counts: 2,4-4,2 (48); 1,4-4,2 (1); and 2,4-5,2 (1). The teeth, particularly the upper three in the major row, are well hooked. The lower tooth in the major row occasionally is straight or with very little curvature at the tip. The teeth in the minor row often are not hooked at their tips, and the grinding surfaces are narrow.

Notropis candidus has from 7 to 11 gill rakers on the first

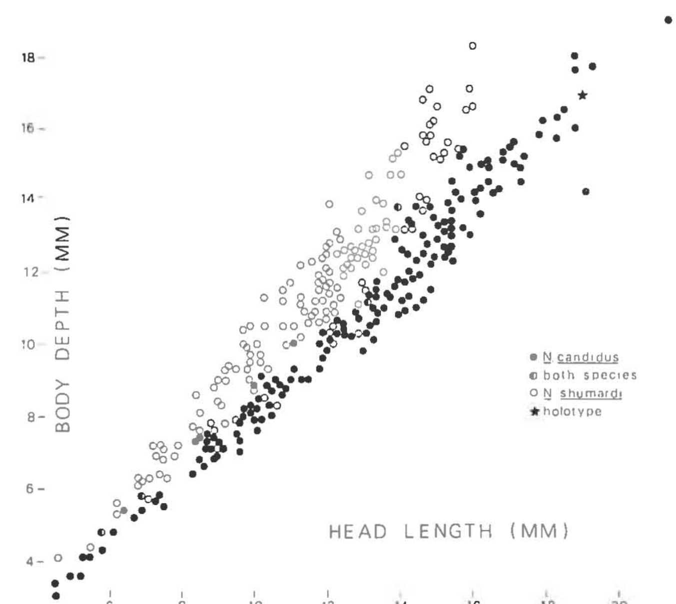


Fig. 4. Relation of body depth to head length in *Notropis candidus* and *Notropis shumardi.* The *N. candidus* specimen with body depth of 19 mm and head length of 21.5 mm is a female 92.4 mm in standard length. The smallest *N. candidus* with body depth of 3.0 mm and a head length of 4.5 mm is 15.5 mm in SL. The largest *Notropis shumardi* with body depth of 18.3 mm and a head length of 16.1 mm is a female, 65.1 mm in SL. The smallest *N. shumardi* with body depth of 4.1 mm and head length of 4.6 mm is 17.3 mm in SL.

arch of the left side. Usually there are 9 rakers, but often there are 8 or 10 (Table 9). The gill raker count for specimens of *N. shumardi* from the lower Mississippi River is usually 8 but is often 7 or 9.

The number of vertebrae for *N. candidus* ranges from 36 to 38 but is usually 37 (Table 3).

The pigmentation of *N. shumardi* and *N. candidus* is quite similar; however, there are a few differences. There are melanophores on the median area of the upper lip of *Notropis shumardi*, but few or no melanophores posteriorly at the corner of the mouth. There are scattered melanophores on the symphsis and the anterior half of the lower jaw, but they do not extend onto the gular area (Gilbert and Bailey, 1962). A few specimens from the lower Mississippi River that were examined for this study do have scattered melanophores on the posterior half of the lower lip (Fig. 5A). *Notropis candidus* has both the upper and lower lip pigmented similarly to *N. shumardi*; however, in most specimens there is an arc of melanophores that extend from the lower lip on one side and across the anterior end of gular region to the lower lip on the opposite side. Some individuals having maximum pigmentation, have melanophores extending a short distance posteriorly on the gular region as illustrated in Fig. 5B. Most specimens of *N. candidus* lack melanophores at the symphysis of the lower jaws, thus, with the ring of melanophores crossing the anterior end of gular region and the melanophores on the median area of the upper lip, a circular light area is formed at the tip of the lower jaw. *Notropis shumardi* usually has melanophores continuous along the lower lips and across the symphysis, and, as stated by Gilbert and Bailey (1962), they do not have a band of melanophores bridging across the gular region.

The size and distribution of melanophores on the dorsal-lateral scales are more uniform in *Notropis candidus* than in *N. shumardi*. The juveniles exhibit the extreme in this contrast. The juveniles of *N. candidus* are well pigmented on the scales of the dorsal-lateral area of the body, whereas juveniles of *N. shumardi* have the scale pockets, or the anterior margins of scales, bordered by a row of large melanophores. These rows seem to cross the middle of the respective overlying scales. If the posterior portion of the scale is lifted away from the body, one can see that the posterior part of scale is devoid of pigment. Thus, when the dorsal-lateral surface is viewed with the unaided eye or slight magnification a diamond or "chicken-wire" pattern is apparent. The larger specimens have additional pigmentation on the scales. The intermediate areas in the chicken-wire pattern are pigmented with small melanophores. Even with additional pigmentation, however, there are usually small lens-shaped unpigmented or thinly pigmented areas. These areas occur at the base of the underlying scale and at margin of the respective overlying scale. Some specimens of *N. candidus* have a distinct broad chevron-shaped spot at the base of the caudal fin but others lack the spot. The predorsal and post dorsal stripe is usually better developed in *N. shumardi* than in *N. candidus*.

VARIATION.—Gilbert and Bailey (1962) presented vertebral counts for specimens from upper Mississippi, lower Mississippi, the Red, Brazos and San Bernard, and

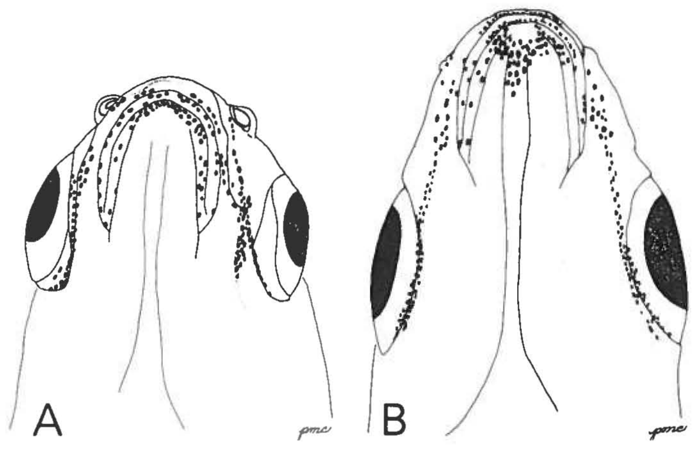


Fig. 5. (A) Ventral view of head region of *Notropis shumardi*. (B) Ventral view of head region of *Notropis candidus*.

Alabama rivers. Vertebral data for my study are presented in Table 3. Gilbert and Bailey (1962) stated that high numbers (mode of 38) occur in the north as well as downstream into the lower Mississippi. The same results are obtained when their data are combined with the Mississippi data (all 165 specimens are from lower Mississippi) presented in this study; that is, no pronounced north-south geographical cline is evident. An appropriate arrangement of vertebral data for the Mobile Bay drainage specimens does not show a north-south cline in *N. candidus*. Thus, perhaps, there is more significance to the divergent counts for the Texas coastal streams than was stated by Gilbert and Bailey (1962). The lower Mississippi River specimens used in this study were from two localities along the lower Mississippi. Forty-nine specimens were from East Carroll Parish, Louisiana which is above the mouth of the Red River, and 105 specimens were taken from the Mississippi River at Norco which is a few kilometers above New Orleans. The East Carroll Parish specimens have a mean of 37.53 vertebrae and the Norco specimens have a mean of 37.55 vertebrae. The Arkansas River specimens have a slightly higher mean value for number of vertebrae than the lower Mississippi specimens used in this study. The 18 specimens of the "type" series of *Alburnops illecebrosus* are included in the Arkansas data. Three of the 18 specimens have 37 vertebrae, 12 have 38 vertebrae and three have 39 vertebrae.

As pointed out by Gilbert and Bailey (1962), the Red River specimens have an intermediate vertebral count between the lower Mississippi and the Brazos River specimens. They postulated (and I agree) that the Texas coastal rivers were populated with a *shumardi* stock via stream transfer between the upper Red River and the Brazos River. John V. Conner (1977) found *N. shumardi* in the Trinity River, and data from some of these specimens are included in this study. A single specimen (TU 106454) of *N. shumardi* was collected from the Neches River on 19 March 1978. There is a question about the natural occurrence in this drainage; I believe its presence in the Neches River is due to introduction by man.

The Trinity River specimens have the lowest vertebral count of any population of *N. shumardi* or *N. candidus*. A probable sequence of transfer of *shumardi* stock was from the Mississippi to the Brazos via the Red River and then from the Brazos to the Trinity River. This stated sequence is based solely on the fact that the Brazos specimens are intermediate between the Red and the Trinity specimens in vertebral counts. No other meristic character, proportions, or pigmentation was analyzed and compared.

ETYMOLOGY.—The Latin word *candidus* means white, bright, shining white or glittering white and is used as descriptive of the sides of the living fish.

ECOLOGY AND REPRODUCTION.—*Notropis candidus* is endemic in the Mobile Bay basin and inhabits the main channel of the Alabama and Tombigbee rivers, the lower portions of the major tributaries and the distributaries flowing into the head of Mobile Bay (Fig. 2). Three specimens were taken from Blakeley River which is in the tidal zone. During daylight hours in the summer months, the adults are usually in the deeper water ranging from a little under one meter to greater depths, whereas at night they move into shallower depths of about a half meter or even less. During the late summer, fall, and spring, the young and juveniles frequent the shallows. During spring, late summer, fall, and early winter to spring, there are young and juveniles mixed in the aggregations of adults. Adults predominated in our catches during the summer months. Only three of 21 samples taken during the months of March, April, June, July, August, and September contained juvenile specimens (Table 10). The three collections containing juveniles were made in March. There were additional samples (not included in Table 10) taken during August and September of various years that included young-of-the-year and juveniles. Many collections taken during the month of December contained numerous young-of-the-year and juveniles.

Spawning takes place during the summer months. Although direct observations of spawning were not made, general examination of specimens at the time of capture and dissection revealed gravid females from early June to early September. June water temperatures ranged from 25 to 29°C (based on 1966, '68, '69, '71, and '73 data). There were relatively few gravid females in late August and early September. Nearly all females in the March samples had only fine granular ova; a few individuals had a small percentage of medium-size pale ova in addition to the minute granular ova. Females in the April samples had mostly medium-size pale ova but a few individuals had large yellowish to orangish ova as well as the medium-size pale ova. Nearly all the females, particularly the larger individuals in the June collections had the large orangish ova as well as the medium-size pale ova. The same gonad condition prevailed in some of the August specimens, but other individuals exhibited partially complete to nearly complete spawned condition. September females exhibited several different sexual conditions, that is; stringy ovary (spawned-out), granular ova only, mixture of granular and medium-size pale ova, and a mixture of medium-size and large ova. The latter condition was typical of the smaller females which were presumably just reaching their sexual maturity and which perhaps would not have spawned until the following summer.

Based on 21 samples (1006 specimens), the sex ratio of adult females to males was approximately 1:2. There were 361 (36 percent) females and 645 (64 percent) males in the 21 samples. Females outnumbered males in only one of the 21 samples. In every sample, females averaged larger than the males. The mean standard length of the 361 females was 66.41 mm and the mean standard length of the 645 males was 60.46 mm (Table 10). The smallest adult female in the June collections was 58.0 mm and the largest was 92.4 mm. Scales were examined from four females collected March 16. Three females, 74.0, 77.8 and 80.4 mm, each exhibited a single annulus. One female, 71.1 mm did not show an annulus. Two females, 70.7 and 71.2 mm from a 2 June collection each showed a recently formed annulus. Four females (72.0, 77.3, 81.9 and 84.5 mm) in a 3 June collection had large ova, indicating a gravid condition. The smallest specimen seems to have had a recently formed annulus, the 77.3 and the 81.9 mm specimens showed considerable growth beyond the first annulus. The largest specimen showed considerable growth beyond the second annulus. In another collection obtained on 3 June, there were nine females, six of which had a single annulus and growth beyond the annulus, and three which did not show an annulus. The one-year-old-plus females were 67.5, 69.4, 74.7, 74.8, 77.0 and 78.2 mm. The three females without an annulus on their scales were 64.4, 66.3 and 68.4 mm. All nine were gravid females with many large ova. A 74.1 mm female collected on 28 June showed a recently formed second annulus. A 63.5 mm female collected on 4 August and a 66.3 mm female collected on 14 August had large ova but neither showed an annulus on their scales. In summary, the spawning population was composed of individuals just reaching the end of their first year of life, one-year-old-plus, and a few two-year-olds.

Males mature at a smaller size than the females. The smallest tuberculate male of 1243 male specimens was 36.9 mm and the largest male was 81.8 mm (Table 11).

Notropis candidus has a rather limited development of breeding tubercles. No females were observed to have breeding tubercles. In males, minute tubercles develop on the top of the head, but very few develop elsewhere on the head or on the body. Typically, the pectoral fins are the only fins with tubercle development. There is a progressive seasonal development of the tubercles on the pectoral fin rays. In March and April, there were individuals with tubercles on the second and third pectoral rays; some with tubercles on the second, third, and fourth rays, and other individuals with tubercles from the second through the eighth ray. In the same collections, there were males with tubercles on the first through the fourth to tenth ray. During the spawning peak (June) most males had well developed tubercles on pectoral fin rays 1-8 or 1-9. A few males had tuberculation extended to the tenth ray. The tubercles are aligned on the rays in single or double rows from the base of the ray out to its branching. Each branch has a single row of tubercles. The anterior pectoral ray usually has a single prominent row of tubercles, but some specimens have an additional one or two interrupted rows of smaller tubercles.

A male specimen 67.3 mm collected on 17 March had considerable growth beyond the first annulus. Another male

(61.8 mm) taken in the same collection seems to have been in the process of forming the first annulus. Two males (61.9 and 66.1 mm) collected on 7 April each showed growth beyond the first annulus. Scales from six males collected on 3 June were examined. Two specimens (50.3 and 53.5 mm) had well developed tubercles on the first eight pectoral fin rays, but neither showed an annulus mark. A 63.4 mm male with tubercles on the first pectoral rays seems to have been in the process of forming the first annulus. The other three males, one 65.0 mm and two 70.0 mm, showed an annulus and growth beyond the annulus. The smaller had tubercles on the first nine pectoral rays and the other two had tubercles on the first eight pectoral rays.

In another collection obtained on 3 June, there were six males that did not show an annulus and five that had a single annulus. The former group ranged from 62.5 to 68.1 mm. The five males with an annulus ranged from 59.2 to 64.2 mm. All eleven specimens had fully developed tubercles on the first nine or ten pectoral rays. The largest male (81.8 mm SL) had tubercles on first eight pectoral fin rays, and it showed some growth beyond the second annulus. This specimen was collected on 11 June 1973. A 71.0 mm male collected on 24 June had a single annulus. Three males taken on 4 August had well developed tubercles on the first eight pectoral rays but they did not have an annulus. These three specimens were 55.1, 60.3 and 60.5 mm. Thus, males in the spawning groups were mostly one-year-olds or just under one year. There were very few two-year-olds.

Numerous males in late August and September collections had regressed tubercles; that is, they were not sharp pointed. Some tubercles appeared to have portions sloughed off, and many specimens had weakly or only moderately developed tubercles.

Table 11 shows that tubercles develop on the anterior rays of the pectoral fins first, except on the first ray. There are a few males in the March and April collections that have tubercles only on the second to eighth pectoral rays. There are also some August and September specimens that lack tubercles on the first pectoral ray. In addition, there are three males that lack tubercles on both the first and second pectoral rays. The small specimens with limited tubercle development may represent individuals that are just reaching sexual maturity. These late-developing individuals probably do not contribute much, if anything, to late summer reproduction.

John V. Conner (*in litt.*) collected ripe *Notropis shumardi* from the Mississippi River near St. Francisville, Louisiana during 1972 and 1973. Ripe specimens were collected from late June to early August with water temperature ranging from 26°C to 29°C. On five occasions when Conner was reasonably sure that he was sampling breeding aggregations; the fish were over hard sand to fine gravel substrate in water one to two meters deep in strong current. Similar conditions were noted by Conner when he sampled spawning *N. shumardi* from the Brazos and Trinity rivers in Texas. The Trinity substrate did have more gravel in some places than the areas sampled in the Brazos.

According to Conner, tuberculation was observed on males taken as early as 3 April and as late as November; however, well developed tuberculation was observed from June to mid-August.

RELATIONSHIP.—*Notropis candidus*, in some features, is morphologically more similar to *Notropis photogenis* than to *Notropis shumardi*. The large eye approaches the size of *N. photogenis*, and the elongate body is somewhat similar to the slim, elongate body of *N. photogenis*. In addition, *N. Photogenis* typically has nine pelvic rays as does *N. candidus* and *N. shumardi*. As pointed out by Snelson (1968), a pelvic fin ray count of nine is unusual for *Notropis* species.

I question the placement of *N. shumardi* as an intermediate between *Notropis (sensu stricto)* and *Luxilus* (Gilbert and Bailey, 1962). I agree with Snelson (1968) in his separation of the subgenus *Notropis* into two "series" or species groups, the *rubellus* series and the *atherinoides* series. I believe that both *N. candidus* and *N. shumardi* should be included in the *atherinoides* series. I do not concur with Snelson (1968) that *N. shumardi* approaches *Notropis blennius* (Girard) in overall appearance. Suttkus and Clemmer (1968) and data presented in Tables 1 and 2 of this study demonstrate some striking differences in general appearance of *N. shumardi* and *N. blennius*, for example, body depth. Unfortunately, our paper (Suttkus and Clemmer, 1968) was in press at the same time as Snelson's (1968) and therefore was not available to him.

Material Examined

Notropis candidus

In addition to the type material, 15,588 specimens (201 series) were examined and used for counts, measurements, description of pigmentation and for the distributional map. None of this material is designated as paratypes. All collections are from the state of Alabama. Materials are listed in order, from upstream to downstream, for the Alabama, Tensaw, and Blakeley river collections, and then for the Tombigbee River system and Mobile River. Standard abbreviations and compass points are used. RM = River Mile.

Alabama River. ELMORE COUNTY: MSU 4098 (15) Alabama River at junction of Coosa and Tallapoosa rivers, 6.4 km SW of Wetumpka, 2 June 1974. DALLAS COUNTY: TU 33385 (1) at Watts, Bar, RM 204.5, 29 June 1964. WILCOX COUNTY: TU 47823 (1) at Hurricane Esland, RM 166.5, 19 August 1967; TU 57732 (10) at Clifton Ferry Landing, RM 137.3, 25 June 1969; plus 422 specimens from 23 June 1970 to 4 December 1973; TU 40299 (7) at Evans Upper Bar, RM 135.8, 7 April 1966; plus 1221 specimens from 28 June 1966 to 4 December 1973; TU 47478 (1) at Evans Lower Bar, RM 133, 9 August 1967; plus 1114 specimens from 28 August 1970 to 25 September 1973; TU 73538 (56) at Holly Ferry Landing, RM 131, 9 December 1971; plus 39 specimens from 17 March 1972 to 25 September 1973; TU 46797 (2) at a new bar above Yellow Jacket Bar, RM 130, 31 May 1967; TU 40313 (25) at Yellow Jacket Bar, RM 129.8, 7 April 1966; plus 432 specimens from 28 June 1966 to 4 December 1973; TU 57776 (9), at Reeves Bar, RM 128.5, 26 June 1969; TU 47937 (1), 26 September 1967; TU 40322 (3) at Tait Bar, RM 122.4, 7 April 1966; plus 184 specimens from 28 June 1966 to 12 June 1973; TU 78179 (8) at Wilcox Bar, isolated pools, RM 120.4, 2 June 1972: TU 40345 (38) at Wilcox Bar, RM 120.4, 7 April 1966; plus 269 specimens from 29 June 1966 to 12 June 1973; TU 41760 (5) at Ohio Bar, RM 111.7, 5 August 1966; plus 13 specimens from 8 August 1967 to 25 September 1968. MONROE COUNTY: TU 41771 (39) at Stein Island, RM 107.5, 5 August 1966; plus 32 specimens from 8 August 1967 to 3 August 1971; TU 47492 (13) at St. James Bar, RM 104, 10 August 1967; TU 70745 (6) at mouth of trib, RM 102, 3 August 1971; TU 47436 (8) at Bates Bar, RM 99.4, 8 August 1967; TU 70787 (4), 3 August 1971; TU 78595 (37) at Davis Ferry Landing, RM 97, 15 August 1972; TU 53316 (1) at Haines Island, RM 96.5, 1 August 1968; TU 47453 (27) RM 96, 8 August 1967; TU 83341 (278) RM 95.5, 29 August 1973; TU 78616 (19) just below Haines Island, RM 94.8, 15 August 1972; TU 83348 (57) at Williamson Woodyard Landing, RM 92.3 29 August 1973; TU 47500 (5) at Silver Creek Bar, RM 87.7, 17 August 1967; TU 41812 (19), 6 August 1966; TU 53352 (1) at Claiborne Lock and Dam, RM 85, 1 August 1968; TU 78641 (76) at mouth of Flat Creek, RM 81.5, 16 August 1972; TU 78652 (2) at RM 80.2, along right (W) bank, 16 August 1972; TU 41822 (1) at mouth of Limestone Creek, RM 80, 6 August 1966; TU 58694 (20), 14 August 1969;

TU 78629 (8), 16 August 1972; TU 65432 (222) along right (W) bank, across from mouth of Limestone Creek. RM 80, 29 August 1970; TU 53361 (2) along right bank at U.S. Hwy 84 bridge, RM 79.2, 1 August 1968; TU 65445 (24), 29 August 1970; TU 70867 (9), 4 August 1971; TU 83376 (37), 28 August 1973. CLARKE COUNTY: TU 35322 (2) along sand bar across from Choctaw Bluff, RM 45, 2 July 1964; TU 99919 (2725) along W bank across from Dixie Landing, RM 39.5, 20 October 1976. BALDWIN COUNTY: TU 90602 (5) RM 26.5, 10 August 1972; TU 90603 (1), 6 August 1973; TU 90604 (20) RM 20.3, 10 August 1972; plus 333 specimens from 11 August 1972 to 16 August 1973; TU 99899 (179) at mouth of Holly Creek at Montgomery Hill Landing, RM 15.5, 20 October 1976; TU 90623 (38) RM 15.0, 14 August 1972; plus 439 specimens from 14 August 1972 to 4 August 1973; TU 90640 (3) RM 9.5, 8 August 1972; plus 82 specimens from 20 August 1972 to 16 August 1973; TU 90646 (42) RM 5.0, 20 August 1972; TU 90647 (3), 23 August 1973; MSU 6843 (696) Tensaw Lake at Hubbard Landing, 21 October 1976; TU 99980 (800) Tensaw Lake at Upper Brants' Landing, 1.6 km NW of Vaughn, 21 October 1976; TU 99969 (225) Tensaw River at Barlow Landing, 21 October 1976; TU 99957 (2417) Tensaw River across from Barlow Landing, 21 October 1976; UAIC 2442 (5) N shore Gravine Island, T3S, R2E, Sec. 7, 10 June 1961; TU 44189 (2) tidal area of Blakeley River, at south end of Meaher State Park, 17 March 1967; TU 56675 (1) W side (right bank) of Blakeley River near mouth, about 9.6 km E of Mobile, 7 March 1969.

Tombigbee River system. PICKENS COUNTY: UAIC 2588 (11) Tombigbee River near Vienna, T24N, R2W, Sec. 34, 17 June 1967; UAIC 2593 (5), 24 June 1967; SUMTER COUNTY: UAIC 2511 (1) Tombigbee River near Warsaw, 23 March 1967; UAIC 3096 (405) Tombigbee River 7.2 air km N Gainesville, T22N, R2W, Sec. 15, 12 September 1968; TU 85700 (264) Tombigbee River 4.8 km N Gainesville, 26 October 1973; TU 85744 (108) Tombigbee River 3.2 km N Gainesville, 26 October 1973; UAIC 1470 (70) Tombigbee River 1.6 air km N Gainesville, T22N, R2W, Sec. 35, 27 September 1964; TU 85771 (13) Tombigbee River along left (E) bank just above mouth of Noxubee River, 26 October 1973; TU 54818 (50) Noxubee River 8.8 km S Dancy, Ala. Hwy 17, 19 October 1968. GREENE COUNTY: TU 76905 (7) Trusells Creek 12.2 km N Boligee, County Hwy. 9, 1 April 1972; TU 76836 (97) tributary to Tombigbee River 4 km SW Forkland, 1 April 1972. TUSCALOOSA COUNTY: UAIC 1056 (1) Black Warrior River at Oliver Dam at Tuscaloosa, 9 October 1963; UAIC 1594 (1), 7 May 1965; UAIC 1595 (3), 10 May 1965; UAIC 1608 (6) 2 June 1965; UAIC 1648 (6), 5 July 1965; UAIC 1694 (15), 14 September 1965; UAIC 2032 (3), 31 May 1966; UAIC 2033 (4), 31 May 1966; UAIC 2515 (13), 31 March 1967; UAIC 1570 (1) Black Warrior River at mouth of Big Sandy Creek, 7 November 1964. SUMTER COUNTY: TU 18981 (2) Tombigbee River ca 1.6 km below Gulf States Paper Plant, Demopolis, 8 August 1958; TU 18991 (3) Tombigbee River 0.4 km below bend in river at Black Bluff, below Demopolis, 7 August 1958. CHOCTAW COUNTY: TU 16137 (87) Tombigbee River below Lock #2, 8.8 km SE Pennington, 1 August 1957. CLARKE COUNTY: TU 52820 (14) Tombigbee River 0.8 W Coffeeville, U. S. Hwy 84 crossing, 27 June 1968; MSU 1385 (10) Tombigbee River at U. S. Hwy 43 crossing near Jackson, 3 July 1970; UAIC 2478 (6) Tombigbee River, T6N, R2E, Sec. 18, 30 July 1963. WASHINGTON COUNTY: UAIC 3376.04 (910) Tombigbee River at McIntosh, 11 September 1976; UAIC 3377.04 (128), 12 September 1976: UAIC 3378.07 (270), 18 September 1976; UAIC 2471 (52) Tombigbee River at Bilbo Island, 18 August 1962; UAIC 2480 (2), 30 July 1963. CLARKE COUNTY: UAIC 2473 (140) Tombigbee River, T3N, R1E, Sec. 26, 18 August 1962. MOBILE COUNTY: UAIC 2470 (34) Mobile River, T1N R1E, Sec. 9, 18 August 1962.

Notropis shumardi

Many hundreds of specimens were examined in a cursory manner. Only those series that were used for counts, measurements and description of pigmentation are listed here by drainage.

Lower Mississippi River. **Tennessee:** DYER COUNTY: UT 44.670 (1) Mississippi River at sand removal site about 1.6 km below new bridge, 11 August 1972. TIPTON COUNTY: UT 44.553 (40) Mississippi River along road 2.4 km W where Tenn. Hwy 59 meets Mississippi River, 29 October 1970. **Mississippi:** WASHINGTON COUNTY: USNM 129057 (5) Mississippi River at Greenville, 25 May 1933. **Louisiana:** EAST CARROLL PARISH: NLU 5037 (94) Mississippi River at Lake Providence, 27 July 1966. CONCORDIA PARISH: NLU 4989 (32) Mississippi River at Natchez bridge, 25 July 1966. POINTE COUPEE PARISH: TU 96423 (4) Mississippi River at upper end of St. Maurice Towhead, RM 273, 19 July 1973. WEST FELICIANA PARISH: TU 96420 (8) Mississippi River at mouth of small tributary at St. Maurice Towhead, 8 March 1973; TU 96419 (19) Mississippi River at U.S. Corps of Engineers dock, RM 265.5, 30 January 1973. POINTE COUPEE PARISH: TU 96422 (39) Mississippi River along right bank at RM 263.3, 4.8 km below St. Francisville, 11 July 1973. WEST FELICIANA PARISH: TU 80214 (1) Mississippi River at upper end of Fancy Point Towhead, RM 258, 27 July 1972; TU 80217 (40), 10 August 1972; TU 96418 (17), 9 August 1972; TU 96417 (5) Mississippi River along W side of Fancy Point Towhead, RM 257.4, 3 April 1972; TU 80215 (2), 7 November 1972; TU 96421 (26), 11 July 1973. ST. CHARLES PARISH: TU 3735 (30) Mississippi River flood pools in front of Bonnet Carré Floodway dam, near Norco, 3 March 1951; TU 8457 (26), 21 March 1953; TU 45535 (23), 21 April 1967; TU 45971 (8), 30 April 1967; TU 46670 (8), 12 May 1967; TU 63067 (15), 27 April 1970. JEFFERSON PARISH: Mississippi River at Waggaman, 29 April 1962.

Arkansas River. **Arkansas:** SEBASTIAN COUNTY: USNM 66 (18) Arkansas River at Ft. Smith, 1852. POPE COUNTY: TU 10246 (20) Arkansas River 6.4 km S Dover, 27 April 1955; TU 14872 (26) Arkansas River at Dardanelle, 11 May 1955.

Red River. **Louisiana.** BOSSIER PARISH: USNM 173315 (36) Red River at La. Hwy 2, T22N, R14W, Sec. 9, 29 March 1962. RAPIDES PARISH: TU 47539 (320) Red River at RM 81.2, 25 August 1967; TU 47557 (171) Red River at RM 78, 25 August 1967.

Trinity River. **Texas:** POLK COUNTY: TU 70897 (23) Trinity River at Taylor Lakes Estates, 3.2 km NW of Post Office in Ace, 28 June 1971. LIBERTY COUNTY: TU 67197 (5) Trinity River at FM 162, 8.5 km W Moss Hill, 20 February 1971; TU 69387 (37), 20 March 1971; TU 69876 (31), 28 June 1971.

Brazos River. **Texas:** BOSQUE COUNTY: TU 4952 (25) Brazos River at mouth of tributary, 6.4 km S Whitney Dam, 8 April 1952. BRAZOS COUNTY: TU 67529 (45) Little Brazos River at Texas Hwy 21 bridge, 11.5 km SW junction Texas Hwy 21 and FM 2818, 19-30 October 1970; TU 35580 (27) Brazos River at "Mussel Shoals" (end of FM 1688), 12.8 km W Bryan, 17 July 1964: TU 35604 (13), 17 July 1964; TU 69532 (51), 21 April 1971.

Nomenclatural History

Gilbert and Bailey (1962) reviewed the complex nomenclatural history of *Notropis shumardi,* which previously had been called *N. illecebrosus.* These taxa, which Girard (1856) had originally proposed in the same paper, were subsequently synonymized by Jordan and Gilbert (1883) under the name *shumardi,* an action that had gone unheeded until the 1962 paper. Gilbert and Bailey (1962) indicated that the type specimens of *N. shumardi* were lost, but subsequently a set of pharyngeal arches were found, purportedly coming from the types. The pharyngeal arches remain in the USNM fish divisions's osteological collection (USNM 68; Comp. Anat. Cat. no. 2675/68), as noted by Gilbert (1978:79). There is also a set of arches (Comp Anat. Cat. no. 2673/66) labeled "Type" *Alburnops illecebrosus.* Data for both of these sets of arches correspond to that given by Girard (1858:262-263).

Girard (1856:30) proposed the genus *Alburnops* in which he placed three species, *A. blennius, A. shumardi* and *A. illecebrosus.* He characterized the genus as having 2,4-4,2 or 1,4-4,2 pharyngeal teeth. Further he stated that the teeth were of the prehensile kind, hooked and with a narrow and sometimes contorted grinding surface. Girard (1858) subsequently presented illustrations and expanded accounts of these taxa, together with catalog numbers and lists of specimens examined. My study of the types and of the original and subsequent descriptions of *A shumardi* and *A. illecebrosus,* together with examination of recently preserved material of *N. shumardi,* reveals certain inconsistencies and disagreements.

Gilbert and Bailey (1962:809) noted that part of the confusion surrounding the nomenclature of *Notropis shumardi* resulted from the inclusion, in the original syntypic series of *A. illecebrosus* (USNM 66), of two species: *N. illecebrosus (=N. shumardi)* and *N. boops*. Hubbs and Ortenburger (1929:29) reported the mixture of five specimens of *Notropis boops* in the syntypic series of *A. illecebrosus*. These five specimens were recataloged as *Notropis boops* on April 23, 1931, and now bear the number USNM 91841. I found upon examination that the five specimens are not *Notropis boops* but are a form of *Notropis volucellus*. Someone had removed, cleaned and replaced the pharyngeal arches of one of the specimens. I removed the pharyngeal arches from the remaining four specimens and found that all five have a pharyngeal formula of 4-4. Thus, on this character alone these specimens could not be referred to *N. boops* which typically has 1,4-4,1 pharyngeal teeth.

I made measurements of the various proportions of Girard's (1858:Pl LVII, Figs. 5, 1. and 13) illustrations of *Alburnops illecebrosus, A. shumardi* and *A. blennius*. According to Girard (1856:30 and 1858:262), *A illecebrosus* has the largest eye of the three species of *Alburnops*, yet the illustration clearly shows *illecebrosus* to have the smallest eye of the three. I found the illustration of *Alburnops illecebrosus* to have the smallest eye, *A shumardi* the next, and *A. blennius* the largest eye in relation to standard and fork length. Other measurements of snout length, head length, and depth of caudal peduncle revealed additional discrepancies between Girard's illustrations and his descriptions of these species.

My present interpretations of the illustrations are as follows. First, Girard's (1858:Pl LVII, fig. 5) illustration of *Alburnops illecebrosus* fits his description of *Alburnops shumardi* on pages 261-2. Second, Girard's illustration (Pl LVII, fig. 1) of *Alburnops shumardi* fits the description of *A. illecebrosus* better than that of *A. shumardi*. Thus, in summary, I suggest that the illustrations are not very accurate, do not fit the descriptions very well, and may be based on a mixture of species. These are essentially the same conclusions arrived at by Hubbs and Ortenburger (1929:29).

Jordan and Gilbert (1883:192-193) presumably described *Notropis boops* for their species no. 274 *(Minnilus shumardi)*. The presence of Girard's name in parentheses following the description indicated that Jordan and Gilbert did not take the description from specimens, nor did they verify the description (see Jordan and Gilbert, 1883, p. vii of Preface). Their decision that *Alburnops shumardi* and *Alburnops illecebrosus* of Girard (1856; 1858) were conspecific was presumably based on their interpretations of Girard's descriptions and illustrations. However, there is a point of confusion. Jordan and Gilbert (1883:193) gave the scale formula as "scales 5-40?-3." The count of "5" above and "3" below came from Girard's text (1858;262), but the lateral line scale count was not given by Girard. Possibly the lateral line scale count was made from Girard's illustration of *A. shumardi*, thus the question mark following the count, but it is peculiar that they did not notice that Girard's (1858: Pl LVII, fig. 1) illustration has seven rows of scales above and five rows below the lateral line.

Another item in the nomenclatural history is Jordan's (1885) article titled, "Identification of the species of Cyprinidae and Catostomidae, described by Dr. Charles Girard, in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1856," where Girard's names and Jordan's identifications are tabulated at the top of page 123. The names of taxa, including types, at the Smithsonian were preceded by a star. *Alburnops shumardi* is not preceded by a star, and Jordan's identification is "*Notropis sp.*" *Alburnops illecebrosus* on the other hand is preceded by a star, and Jordan's identification is "*Notropis illecebrosus.*" It seems quite obvious that the two syntypic specimens of *A. shumardi* were either lost, unidentifiable, or without a label at this early date. Apparently Jordan was not aware of the materials stored in the Comparative Anatomy Collection.

Chronologically, the next step in the literature in regard to the nomenclature of *Notropis shumardi*, is Jordan and Evermann's (1896) "Fishes of North and Middle America." I agree with Gilbert and Bailey (1962:809) that Jordan and Evermann's description of *Notropis illecebrosus* fits that of *Notropis boops;* however, Jordan and Evermann's (1896:268) description of *Notropis shumardi* also could be that of *Notropis boops*. In fact, they placed *Notropis boops* of Gilbert (1885) in synonymy of *Notropis shumardi*. Also, Jordan and Evermann's reference to the "eye very large, 2⅓ to 3 in head...teeth 1,4-4,1 (2,4-4,2 according to Girard)... and distribution, Ohio and Tennessee basins to Iowa and Ozark region, in cold streams and springs; abundant in Arkansas, and in northern Alabama" leaves no doubt that they were referring to what we presently call *Notropis boops* and not to what we presently call *Notropis shumardi* following Gilbert and Bailey.

Although there are frequent disagreements between the number of extant specimens in type series and the number of specimens listed for type series by Girard in his early papers, the situation with *Alburnops illecebrosus* seems worthy of mention. Girard (1858:263) gave 24 as the number of specimens in the type series. Hubbs and Ortenburger (1929:29) stated that there were 18 specimens in the type series at the National Museum, three cotypes in the Museum of Comparative Zoology, and a single cotype at each the Academy of Natural Sciences of Philadelphia, the Museum of Zoology of the University of Michigan, and the Field Museum at Chicago. The extant material at that time equaled 24 specimens. A check in November of 1977 revealed the same distribution of type material except that instead of three there are only two cotypes at the Museum of Comparative Zoology. This recent discrepancy does not negate the significance of the past agreement between the number of extant specimens and Girard's (1858) published number (24) of specimens. I suggest that the five *N. volucellus* (USNM 91841) specimens formerly misidentified as *N. boops* were not in Girard's original syntypic series of *A. illecebrosus* but were mixed in at a later date.

The extant set of pharyngeal arches of the "type" of *Alburnops shumardi* has 2,4-4,2 teeth. I question the identity of these arches. A comparison of the arches with several sets of arches from specimens of *Notropis shumardi* collected from the lower Mississippi River, shows rather good agreement in proportions except for the width of the upper arm of the arch and the relative size of the teeth. The arches of the "type" of *Alburnops shumardi* have a somewhat broader upper arm than the six sets of arches from the recently collected specimens. The teeth of the "type", although not measured, appear to be larger in proportion to the arch.

As mentioned above, there is a set of pharyngeal arches of *Alburnops illecebrosus* labeled as "type" which was in the Comparative Anatomy collection of former years. Also, one of 18 syntypes remaining at the National Museum is without arches; presumably these are the arches that were placed in the Comparative Anatomy collection. A comparison of measurements of the *A. illecebrosus* arches with the six sets of arches from the recently collected specimens of *Notropis shumardi* shows very close agreement in all proportions.

Girard (1858:262-263) stated that his illustrations of *Alburnops shumardi* and *Alburnops illecebrosus* were "size of life." The illustration of the former is about 70 mm in standard length, and the latter is about 68 mm in standard length. The largest specimen of the 18 syntypes of *A. illecebrosus* at the United States National Museum is slightly over 62 mm. The slight difference in size of the types could not account for the differences in proportions of the pharyngeal teeth and arches.

Gilbert and Bailey (1962) took the necessary action to reestablish the name *shumardi.* They did this following the line priority rule, coupled with the fact that Jordan and Gilbert (1883), as first revisers, put *illecebrosus* in the synonymy of *shumardi.* They said, "We therefore reapply the name *shumardi,* and we designate as lectotype of *Alburnops shumardi* the specimen (now presumably lost) that formed the basis for the illustration (Girard, 1858; Pl 57, fig. 1)." Gilbert (1978) listed the "type" set of pharyngeal teeth as syntypic material. I would have expected Jordan, Evermann and Clark's (1930) placement of *illecebrosus* in the synonymy of *shumardi* to have established the use of *shumardi* over Fowler's (1910) choice of *illecebrosus.* An examination of the literature between 1930 and 1962 clearly demonstrates the use of the name *illecebrosus* in spite of the checklist. Authors subsequent to Gilbert and Bailey (1962) have used the name *shumardi,* except Clay (1975), who chose to continue usage of *illecebrosus.*

I have indicated in the foregoing discussion that discrepancies exist between Girard's (1858) illustrations and his descriptions. Secondly, the extant set of pharyngeal arches of the "type" of *Alburnops shumardi* differs in some respects from pharyngeal arches of the silverband shiner. In my opinion these discrepancies are insufficient in themselves to warrant a change in trivial name usage especially because I am not prepared to make a positive identification of the pharyngeal arches of the "type" of *A. shumardi.* Therefore, I suggest we continue to use the name *Notropis shumardi* for the silverband shiner as proposed by Gilbert and Bailey (1962).

Literature Cited

Clay, W. M. 1975. The fishes of Kentucky. KY Dept. Fish and Wildlife Resources, Frankfort, KY. vii + 416 pp.

Conner, J. V. 1977. Zoogeography of freshwater fishes in western Gulf Slope drainages between the Mississippi and the Rio Grande. Unpubl. Ph.D. dissertation, Tulane University, 1-268. pp.

Douglas, N. H. 1974. Freshwater fishes of Louisiana. La. Wildlife and Fish. Comm. and Claitor's Publishing Div., Baton Rouge, La. viii + 443 pp.

Fowler, H. W. 1910. Notes on the variation of some species of the genus *Notropis.* Proc. acad. Nat. Sci. Phila. 62:273-93.

Gilbert, C. R. 1978. Type catalogue of the North American cyprinid fish genus *Notropis.* Bull. Florida State Mus., Biol. Sci. 23 (1):104 pp.

__________, and R. M. Bailey, 1962. Synonymy, characters, and distribution of the American cyprinid fish *Notropis shumardi.* Copeia, 1962 (4):807-819.

Girard, C. 1856. Researches upon the cyprinoid fishes inhabiting the freshwaters of the United States, west of the Mississippi Valley, from specimens in the Museum of the Smithsonian Institution. Proc. Acad. Nat. Sci. Phila. 54 pp. (preprint)

__________. 1858. Fishes, p. 1-400. *In:* General report on the zoology of the several Pacific railroad routes. U. S. Pacific R. R. Survey 10(4).

Hubbs, C. L. and K. F. Lagler, 1958. Fishes of the Great Lakes region. Rev. ed. Bull. Cranbrook Inst. Sci. (26) vi + 213 pp.

__________, and A. I. Ortenburger, 1929. Further notes on the fishes of Oklahoma, with descriptions of new species of Cyprinidae. Publ. Univ. Oklahoma Biol. Survey 1 (2): 15-43.

Jordan, D. S. 1885. Identification of the species of Cyprinidae and Catostomidae, described by Dr. Charles Girard, in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1856. Proc. U. S. Natl. Mus. 8(500):118-127.

__________, and B. W. Evermann. 1896. The fishes of North and Middle America. Bull. U. S. Natl. Mus. 47 (1) lx + 1240 pp.

__________, B. W. Evermann and H. W. Clark. 1930. Check list of the fishes and fish-like vertebrates of North and Middle America, north of the northern boundary of Venezuela and Columbia. Rept. U. S. Comm. Fish. 1928 (2):670 pp.

__________, and C. H. Gilbert. 1883. Synopsis of the fishes of North America. Bull. U. S. Natl. Mus. 16, lvi + 1018 pp.

Miller R. J. and H. W. Robison, 1973. The fishes of Oklahoma. Oklahoma State Univ. Press, Stillwater, OK. xiii + 246 pp.

Moore, G. A. 1968. Fishes, *In.* W. F. Blair *et al.*, Vertebrates of the United States. McGraw-Hill Book Co., New York. pp 22-165.

Pflieger, W. L. 1971. A distributional study of Missouri fishes. Univ. Kansas Publ. Mus. Nat. Hist. 20:225-570.

__________. 1975. The fishes of Missouri. Mo. Dept. Cons., viii + 343 pp.

Smith-Vaniz, W. F. 1968. Freshwater fishes of Alabama. Auburn Univ. Agr. Exp. Sta., Auburn, AL. vii + 211 pp.

Snelson, Jr., F. F. 1968. Systematics of the cyprinid fish *Notropis amoenus,* with comments on the subgenus *Notropis.* Copeia, 1968 (4): 776-802.

Suttkus, R. D. and G. H. Clemmer. 1968. *Notropis edwardraneyi,* a new cyprinid fish from the Alabama and Tombigbee River systems and a discussion of related species. Tulane Stud. Zool. and Bot., 15 (1):18-39.

Table 1. Measurements of *Notropis candidus* and *Notropis shumardi* Expressed in Thousandths of Standard Length. Mean Value Given in Parentheses.

Species Catalog Number	*N. candidus* TU 103415 Holotype		*N. candidus* TU 57763 Paratopotypes			*N. shumardi* TU 96421	
River System	Alabama River		Alabama River			Mississippi River (lower)	
Sex	♀	5 ♂♂	5 ♀♀	♂♂ and ♀♀	4 ♂♂	6 ♀♀	♂♂ and ♀♀
Standard length (mm)	80.1	58.4-74.0 (64.4)	64.3-92.4 (73.4)	58.4-92.4 (68.9)	59.0-63.5 (61.7)	58.3-64.4 (60.6)	58.3-64.4 (61.0)
Predorsal Length	509	486-503 (495)	485-500 (495)	485-503 (495)	491-519 (501)	498-508 (503)	491-519 (502)
Dorsal Origin to base of caudal	517	525-546 (539)	528-541 (534)	525-546 (537)	520-534 (528)	518-530 (525)	518-534 (526)
Prepelvic length	487	457-483 (472)	471-488 (478)	471-488 (475)	465-491 (479)	476-492 (484)	465-492 (482)
Preanal length	690	671-687 (678)	674-705 (693)	671-705 (685)	676-688 (682)	679-694 (688)	676-694 (686)
Head Length	238	227-244 (236)	230-236 (233)	227-244 (235)	236-251 (241)	235-250 (243)	235-251 (242)
Head depth	146	140-154 (147)	140-148 (145)	140-154 (146)	167-174 (170)	163-172 (168)	163-174 (169)
Head width	127	117-127 (122)	118-130 (122)	117-130 (122)	140-142 (141)	135-141 (138)	135-142 (139)
Width of fleshy interorbital	86	81-84 (83)	82-87 (84)	81-87 (84)	90-98 (93)	92-99 (95)	90-99 (94)
Snout length	75	69-75 (72)	70-78 (73)	69-78 (73)	69-73 (71)	68-74 (71)	68-74 (71)
Diameter of orbit	64	63-67 (64)	59-63 (62)	59-67 (63)	65-61 (58)	58-64 (62)	56-64 (60)
Length of lower jaw	60	54-58 (56)	53-58 (57)	53-58 (56)	60-64 (61)	62-64 (63)	60-64 (62)
Greatest body depth	211	193-202 (198)	199-215 (205)	193-215 (202)	259-270 (264)	238-261 (252)	238-270 (257)
Greatest body width	131	119-127 (124)	117-141 (127)	117-141 (126)	164-186 (173)	147-168 (157)	147-186 (164)
Caudal peduncle length	221	211-231 (220)	207-230 (217)	207-231 (218)	198-220 (211)	203-214 (207)	198-220 (209)
Caudal peduncle depth	106	100-110 (104)	92-104 (98)	92-110 (101)	118-121 (119)	117-125 (121)	117-125 (120)
Length of depressed dorsal fin	211	199-226 (216)	197-213 (208)	197-226 (212)	225-252 (235)	242-258 (251)	225-258 (244)
Length of depressed anal fin	162	163-175 (168)	157-163 (160)	157-175 (164)	178-195 (186)	177-202 (189)	177-202 (188)
Length of pectoral fin	171	175-190 (181)	163-176 (169)	163-190 (175)	181-203 (191)	183-195 (187)	181-203 (189)
Length of pelvic fin	151	143-159 (152)	143-154 (148)	143-159 (150)	148-178 (159)	154-167 (162)	148-178 (161)

Table 2. Measurements of *Notropis candidus* and *N. shumardi* Expressed in Thousandths.

Species	*N. candidus*						
Class Limits		15.0-24.9(mm)	X̄	25.0-34.9(mm)	X̄	35.0-44.9(mm)	X̄
Number of Specimens	Holotype	9	9	19	19	34	34
Standard length (mm)	80.1	15.5-23.1	19.8	25.4-34.8	31.2	35.1-44.0	40.1
Head length/Standard length	238	254-290	268	244-267	257	234-258	248
Head depth/Head length	618	596-667	627	587-672	629	581-640	607
Head width/Head length	534	467-511	481	467-511	494	471-550	502
Orbit diameter/Head length	267	310-355	328	264-337	301	273-326	304
Body depth/Head length	885	667-827	747	733-870	809	729-892	805
Body width/Head length	550	422-500	459	448-512	480	441-538	488
Caudal peduncle depth/Head length	445	333-400	368	372-423	397	375-450	406
Orbit diameter/Body depth	302	375-472	441	324-426	372	315-426	349
Orbit diameter/Body width	486	620-773	717	548-725	627	538-689	625
Orbit diameter/Caudal peduncle depth	600	783-1000	894	639-906	759	643-820	749

Species	*N. shumardi*						
Class Limits		15.0-24.9(mm)	X̄	25.0-34.9(mm)	X̄	35.0-44.9(mm)	X̄
Number of Specimens		5	5	24	24	36	36
Standard length (mm)		17.3-23.9	21.3	25.8-34.2	29.9	35.1-44.9	39.6
Head length/Standard length		259-271	266	243-271	260	239-275	253
Head depth/Head length		673-761	705	644-726	691	632-870	690
Head width/Head length		491-532	519	493-583	541	481-592	547
Orbit diameter/Head length		273-293	279	263-382	300	254-316	280
Body depth/Head length		800-903	855	789-1024	899	783-1072	951
Body width/Head length		491-522	509	467-643	539	467-678	583
Caudal peduncle depth/Head length		418-546	435	389-512	450	406-510	467
Orbit diameter/Head length		303-354	327	267-426	335	240-367	297
Orbit diameter/Body width		531-680	549	426-722	559	391-600	486
Orbit diameter/Caudal peduncle depth		619-680	642	524-867	700	928-743	603

N. candidus continued

45.0-54.9 (mm)	X̄	55.0-64.9(mm)	X̄	65.0-74.9(mm)	X̄	75.0-84.9(mm)	X̄	85.0-94.9(mm)	X̄
35	35	70	70	30	30	10	10	3	3
45.1-54.9	50.7	55.3-64.9	60.0	65.2-74.4	68.8	75.2-83.5	78.8	85.3-92.4	88.1
231-260	243	225-257	242	227-246	237	223-252	232	215-233	225
577-658	611	570-650	602	580-650	607	573-636	605	602-619	613
477-543	510	477-545	505	484-533	513	474-545	523	505-538	518
278-328	303	260-318	289	269-300	284	259-286	272	256-294	271
754-975	836	759-985	843	771-975	881	739-952	876	884-914	895
472-601	504	443-571	505	443-691	523	463-571	527	474-554	513
400-462	433	387-485	428	391-452	425	385-451	428	395-441	414
320-408	366	297-398	346	291-369	321	278-387	312	289-322	303
424-666	608	500-661	578	474-614	542	454-617	518	476-619	534
637-808	703	573-775	679	603-750	669	576-744	638	597-722	655

N. shumardi cont.

45.0-54.9 (mm)	X̄	55.0-64.9(mm)	X̄	65.0-74.9(mm)	X̄
92	92	31	31	2	2
45.0-54.9	49.5	55.0-64.4	59.6	65.1-66.4	65.7
232-272	251	235-262	246	241-247	244
628-745	679	648-720	686	725-739	732
482-629	550	527-606	566	619-633	626
240-301	271	233-295	265	250-261	255
820-1149	959	868-1148	1024	1069-1137	1103
447-744	581	507-789	627	656-733	649
413-528	469	424-523	477	431-472	451
231-350	283	208-296	251	229-234	231
389-600	471	302-513	413	356-381	368
507-673	584	473-603	538	553-580	566

Table 3. Total Number of Vertebrae of *Notropis candidus* and *N. shumardi.*

Species and drainage	34	35	36	37	38	39	N	X̄
N. candidus								
Alabama River			63	225	33		321	36.91
Tombigbee River			24	104	10		138	36.90
Totals			87	329	43		459	36.90
N. shumardi								
Mississippi River	1	—	9	61	84	10	165	37.56
Red River		1	19	57	9		86	36.86
Arkansas River				7	48	9	64	38.04
Trinity River	20	60	11				91	34.89
Brazos River	5	60	50	1			116	35.40

Table 4. Number of Lateral Line Scales of *Notropis candidus* and *N. shumardi.*

Species and drainage	34	35	36	37	38	39	N	X̄
N. candidus								
Noxubee River		8	26	6				
Tombigbee River	1	18	79	9				
Alabama River	4	123	470	106	3			
Blakeley River			3	1				
Totals	5	149	578	122	3		857	35.96
N. shumardi								
lower Mississippi River	1	5	47	63	18	1	135	36.70

Table 5. Body Circumference Scale Row Counts of *Notropis candidus* and *N. shumardi.*

Species and drainage	20	21	22	23	24	25	26	27	28	29	N	X̄
N. candidus												
Noxubee River		1	6	7	23	5	1					
Tombigbee River		2	10	27	53	9	7					
Alabama River	2	12	88	141	382	53	23	4	2			
Blakeley River					3							
Totals	2	15	104	175	461	67	31	4	2		861	23.67
N. shumardi												
lower Mississippi River			2	6	43	52	26	11	5	2	147	25.07

Table 6. Number of Anal Fin Rays of *Notropis candidus* and *N. shumardi.*

Species and drainage	7	8	9	10	11	N	X̄
N. candidus							
Noxubee River	1	49					
Tombigbee River	8	101	4				
Alabama River	27	729	16				
Blakeley River		3					
Totals	32	882	20			934	7.99
N. shumardi							
lower Mississippi River		55	116	9	2	182	8.77

Table 7. Left Pectoral Fin Ray Counts of *Notropis candidus* and *N. shumardi*.

Species and drainage	12	13	14	15	16	17	18	N	X̄
N. candidus									
Noxubee River*			6	33	10				
Tombigbee River		1	14	61	32	1			
Alabama River	1	7	122	359	195	23	1		
Blakeley River			1	2					
Totals	1	8	143	455	237	24	1	869	15.14
N. shumardi									
lower Mississippi River		5	69	106	12	1		193	14.66

*one with nine rays

Table 8. Number of Pelvic Fin Rays of *Notropis candidus* and *N. shumardi*.

Species and drainage	7—9	8—8	8—9 9—8	9—9	9—10 10—9	10—10	10—8	N	X̄
N. candidus									
Noxubee River		2	3	42	-	2	1		
Tombigbee River		4	5	90	5	5			
Alabama River		27	45	564	43	28			
Blakeley River				3					
Totals		33	53	699	48	35	1	869	9.00
N. shumardi									
lower Mississippi River	1	27	28	123	1			180	8.77

Table 9. Number of Gill Rakers on First Left Arch of *Notropis candidus* and *N. shumardi*.

Species and drainage	6	7	8	9	10	11	N	X̄
N. candidus								
Tombigbee River		3	29	37	16	2	87	8.83
N. shumardi								
lower Mississippi River	1	10	43	25	2	1	82	8.24

Table 10. Sex-ratio in 21 samples (1006 specimens) of *Notropis candidus* from Alabama River.

Date of Collection	Catalog Number	Number ♀♀	Number ♂♂	Percent ♀♀	Percent ♂♂	x̄ size (SL in mm) ♀♀	♂♂
16 March 1972	TU 76231*	71	53	57	43	69.18	64.42
16 March 1972	TU 76253*	93	103	47	53	65.24	64.23
19 March 1974	TU 86774*	36	79	31	69	65.12	62.58
7 April 1966	TU 40299	2	5	29	71	60.05	58.58
7 April 1966	TU 40313	6	19	24	76	68.02	61.83
25 June 1969	TU 57743	11	34	24	76	69.76	62.62
26 June 1969	TU 57763	28	57	33	67	68.73	61.75
28 June 1966	TU 40903	4	22	15	85	61.95	59.07
28 June 1966	TU 40928	5	8	38	62	70.46	61.16
28 June 1966	TU 52767	7	9	44	56	69.80	63.14
29 June 1966	TU 40947	6	26	19	81	63.80	58.72
29 June 1968	TU 52832	12	25	32	68	70.09	64.35
29 June 1968	TU 52854	2	21	9	91	70.30	61.80
1 July 1966	TU 41414	15	20	43	57	69.49	60.48
5 August 1966	TU 41771	13	26	33	67	65.50	60.42
6 August 1966	TU 41812	7	12	37	63	65.17	58.81
8 August 1967	TU 47453	10	17	37	63	62.17	58.49
10 August 1967	TU 47492	5	8	38	62	65.28	53.87
26 September 1967	TU 47903	22	87	20	80	66.13	58.34
26 September 1967	TU 47925	1	6	14	86	62.40	59.07
27 September 1967	TU 48013	5	8	38	62	65.92	56.04
Totals		361	645	36	64	66.41	60.46

*8 additional juveniles in TU76231; 7 additional juveniles TU76253; 97 additional juveniles in TU 86774.

Table 11. Tubercle distribution on left pectoral fin rays in *Notropis candidus* from the Alabama River.

Date of Collection	Range in Size (SL in. mm)	Number of Specimens	3-5	2-3	2-4	2-5	2-6	2-7	2-8	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11
15-17 Mar 1970, 72	53.0-80.2	179		2	2	3	5	1		1	10	34	89	28	2		
7 Apr 1966	54.0-59.0	49						1	3				9	28	7	1	
1- 3 June 1971, 72	43.7-80.7	187											1	35	80	21	
11-12 June 1973	52.2-81.8	143												26	83	31	3
23-26 June 1969, 70	53.4-74.0	117											7	62	43	5	
28- 1 July 1966, 68	51.9-72.6	134											7	80	46	1	
1-11 Aug 1958, 66-69, 71	46.5-72.6	101										1	11	64	23	2	
14-16 Aug 1969, 72	39.4-68.5	86	1				13	3	1			1	14	37	15	1	
27-29 Aug 1970,73	36.9-71.8	153											46	89	17	1	
14-17 Sep 1971, 72	42.0-51.8	9	2			2	2	3									
23-27 Sep 1967-70,73	46.3-72.3	85					4				1	10	23	36	11		
	36.9-81.8	1243	3	2	2	5	24	8	4	1	11	46	207	485	327	63	3

Noturus stanauli, a new madtom catfish (Ictaluridae) from the Clinch and Duck Rivers, Tennessee

David A. Etnier
Department of Zoology, University of Tennessee Knoxville, Tenn. 37916

Robert E. Jenkins
Department of Biology, Roanoke College Salem, Va. 24153

ABSTRACT: Etnier, David A. and Robert E. Jenkins, 1980. *Noturus stanauli*, a new madtom catfish (Ictaluridae) from the Clinch and Duck Rivers, Tennessee. Bulletin Alabama Museum of Natural History, Number 5:17-22, 2 tables, 2 figs. *Noturus stanauli*, a new species of madtom catfish (Ictaluridae) of the *hildebrandi* species group, subgenus *Rabida*, is described from single localities in the Clinch and Duck rivers, Tennessee River drainage, Tennessee. The only known localities for the species are separated by 656 river miles. It is the smallest of the known madtoms, with 2 of 41 available specimens about 36 mm and the remaining 39 less than 34 mm standard length. *Noturus stanauli* differs from other members of the *hildebrandi* species group in having well-developed anterior serrae on the pectoral spines, in addition to pigmentation and meristic and morphometric characters. The extremely limited distributions of the species has led the Tennessee Wildlife Resources Agency to recognize it as a Threatened species, and the U.S. Fish and Wildlife Service Office of Endangered Species is considering a similar status for *N. stanauli*. The consistent presence of a rudimentary anterior pelvic ray, similar to that of *Ictalurus* and *Pylodictis*, promoted a survey of cleared and stained specimens of most other madtom species. The rudimentary ray was frequently present in the *hildebrandi* and *elegans* species groups of the subgenus *Rabida*, but was typically lacking in *eleutherus* and the *furiosus* and *miurus* species groups of that subgenus. The common occurrence of the rudimentary ray in *N. (Noturus) flavus*, and its absence from all members of the subgenus *Schilbeodes*, except *N. gyrinus*, strengthens earlier phylogenetic placement of species, species groups, and subgenera of *Noturus*.

Editorial Committee for this paper:

Dr. Neil H. Douglas, Museum of Zoology, Northeast Louisiana University, Montoe, Louisiana 71209
Dr. Royal D. Suttkus, Museum of Natural History, Tulane University, Belle Chasse, Louisiana 70037
Dr. Ralph Yerger, Department of Biological Sciences, Florida State University, Tallahassee, Florida 32306

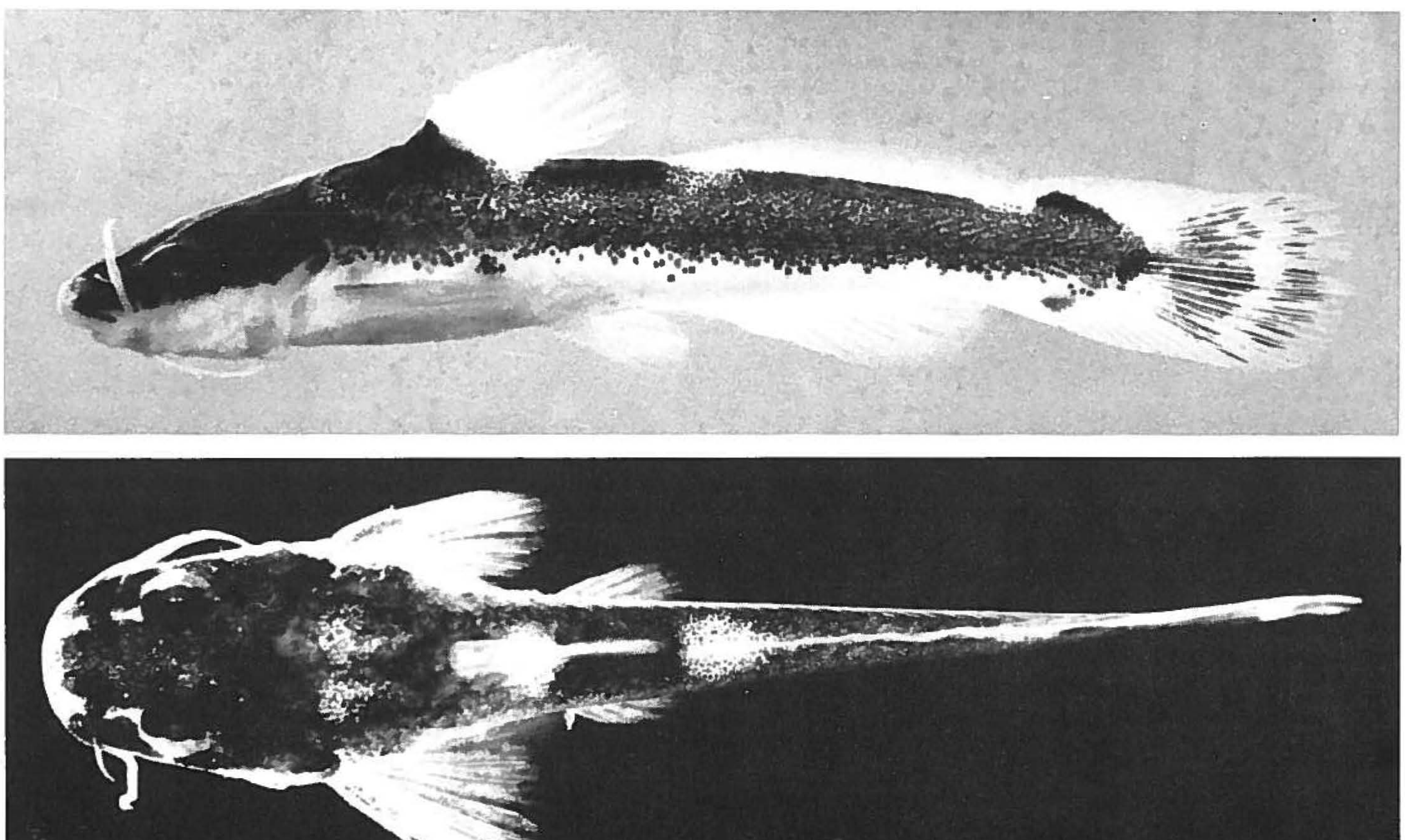
Introduction

Several species of ictalurid catfishes of the genus *Noturus* have baffled North American ichthyologists because of their extremely fragmented distributions and apparent rarity. *Noturus flavipinnis* was known from five localities in the Tennessee River drainage of Georgia, Tennessee, and Virginia between 1884 and 1893. The species was described by Taylor (1969) and was considered as possibly extinct. Taylor et al (1971) reported the rediscovery of this species based on a single specimen from Powell River, Hancock County, Tennessee, and many specimens from Copper Creek, tributary to Clinch River, Scott County, Virginia. *Noturus trautmani*, known only from the extremely well-collected Big Darby Creek in Ohio, has appeared only in collections taken between 26 September and 30 December. The 17 available specimens were all taken from the same riffle area between 1943 and 1957 (Taylor, 1969). *Noturus eleutherus*, formerly unknown from the Mississippi River Embayment Province, but occurring in both the Ozark and Appalachian uplands, is now known from a single 1973 specimen (UT 48.138) from the Mississippi River in Tipton County, Tennessee. *Noturus miurus* was not collected from the Cumberland River drainage above Cumberland Falls until 1975, when a single specimen was taken in No Business Creek, Campbell County, Tennessee (Starnes and Starnes, 1978). *Noturus elegans* is widespread in the Barren and Green river systems of Kentucky and Tennessee. Tennessee specimens from the Duck and Buffalo rivers, also referred to this species, are different in appearance from those from the Barren and Green river systems, from remote localities in the Tennessee and Cumberland drainages (Taylor, 1969), and from Ruin Creek, Sandy River system (Ohio River basin), Elliott County, Kentucky (UT 48.283). We have four recently collected specimens from the middle portion of the Duck River that suggest that two species of the *N. elegans* complex occur in that river. This situation is currently being investigated by D. A. Etnier and W. C. Starnes. *Noturus baileyi* is still known only from the five type specimens from Abrams creek, tributary to the Little Tennessee River, Blount County, Tennessee, 8 June 1957, and may be extinct.

We add to the above an additional enigmatic and very interesting species known from single localities in the well-collected Clinch and Duck rivers, tributaries to the Tennessee River. These localities are separated by 656 river miles.

Counts and measurements were made by methods of Hubbs and Lagler (1958), Bailey and Taylor (1950), and Taylor (1969). The University of Tennessee Research Collection of Fishes provided comparative material of other madtom species. Cleared and stained material in the University of Tennessee collection was prepared by Bruce H. Bauer and Don E. Lewis. The photographs were provided by Richard T. Bryant and W. C. Starnes.

Fig. 1. Lateral view (above) and dorsal view of *Noturus stanauli* (UMMZ 203254, 23 mm SL).



Noturus stanauli, new species
Pygmy Madtom
(Fig. 1)

HOLOTYPE.—Tulane University (TU) 110929, 36.2 mm standard length (SL), Clinch River at Frost Ford, Clinch River Mile 181.1, 11.8 air km WSW of Kyles Ford, Hancock County, Tennessee, 21 April 1978, D. L. Batch, B. H. Bauer, B. A. Branson, R. T. Bryant, D. A. Etnier, J. L. Harris, J. A. Louton, M. G. Ryon.

PARATOPOTYPES.—Paratypes taken with the holotype are TU 110930(5); and University of Tennessee (UT) 48.318(1), cleared and stained. Other paratopotypes are Academy of Natural Sciences Philadelphia 139746(1), 25 September 1971; UT 48.199(2), 30 April 1974; UT 48.329(2), 17 November 1974; UT 48.330(3), 17 November 1974; UT 48.218(1), 6 July 1975; UT 48.355, 30 November 1975; Eastern Kentucky University 992(3), 12 April 1976; National Museum of Natural History (USNM) 219281(1), 1 May 1976; UT 48.244(1), 4 November 1976; Florida State Museum 25974(2), 24 April 1977; Northeast Louisiana University 41863(1), 13 October 1977; University of Michigan Museum of Zoology (UMMZ) 203254(5), 9 April 1978; and Illinois Natural History Survey 83899(1), 24 October 1978.

OTHER PARATYPES.—All from Duck River just above mouth of Hurricane Creek, Duck River Mile 17.5, Humphreys County, Tennessee: USNM 219282(1), 20 September 1972; USNM 219283(2), 29 August 1973; USNM 219284(1), 28 April 1974; and USNM 219285(2), 21 October 1978.

DIAGNOSIS.—*Noturus stanauli* is a member of the subgenus *Rabida* as diagnosed by Taylor (1969). Differs from other *Rabida* except *N. albater* and members of *hildebrandi* and *elegans* species groups (Taylor, 1969; Douglas, 1972) in having short and virtually straight rather than long and curved pectoral spines, and a humeral process shorter than diameter of pectoral spine. Differs from *N. albater* and members of *elegans* species group (*N. elegans, N. taylori, N. trautmani*) in having modally 8 rather than 9 pelvic rays, modally 47 or fewer caudal rays rather than 49 or more (Table 1), and immaculate rather than well pigmented lower sides. Most similar to members of *hildebrandi* species group (*N. h. hildebrandi, N. h. lautus, N. baileyi*), but differs from these in having well developed anterior serrae on pectoral spines and a shorter humeral process (Fig. 2). Soft pectoral rays modally 8 as opposed to modally 9 in both subspecies of *N. hildebrandi*. Preoperculomandibular canal pores typically 11 as opposed to 10 in *N. h. lautus*. Anal rays 14 to 17 as opposed to 12-13 in *N. baileyi*. Differs from *N. baileyi* and *N. h. hildebrandi* in having most of lower sides immaculate as opposed to well-pigmented, and from all taxa in *hildebrandi* group in having anterior dorsal portion of snout immaculate as opposed to well-pigmented. *Noturus stanauli* also differs from members of *hildebrandi* group in having three spots at caudal base that are typically darker than background body coloration. These spots, located at base of middle 10 to 14 caudal rays and over bases of both upper and lower procurrent caudal rays (Fig. 1), either absent or of same intensity as background body pigmentation in other members of *hildebrandi* species group. *Noturus*

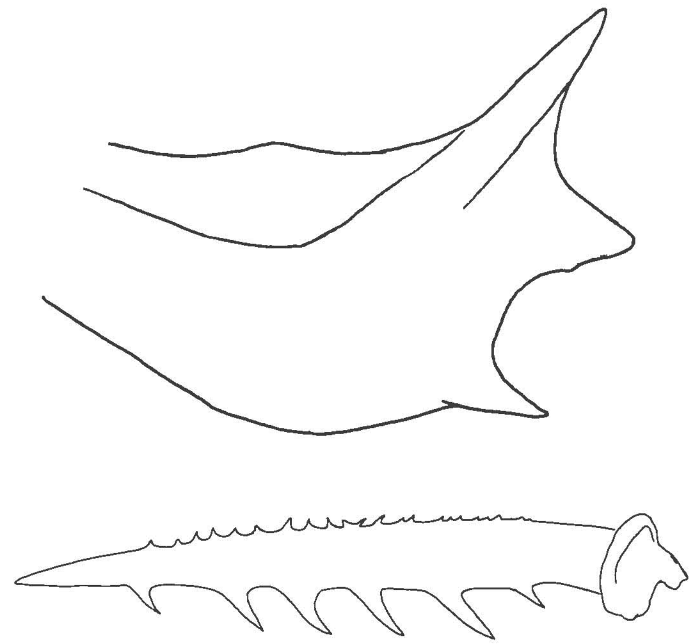


Figure 2. Left cleithrum (above) and left pectoral spine of *N. stanauli*.

stanauli appears to differ from *N. h. hildebrandi* (see Bailey and Taylor, 1950) in the following ratios (expressed as thousandths of SL): dorsal origin to adipose origin, adipose length, anal base length, and lengths of maxillary and outer mental barbels (Table 2). Further differing from all other *Noturus* in its apparently smaller size (2 specimens are 36.1 and 36.2 mm SL; remaining 39 range from 22 to 33 mm SL).

DESCRIPTION.—*Noturus stanauli*, based on 41 available specimens, is the smallest ictalurid catfish known (see Diagnosis). It is a slender species, with a head that is flat in lateral view and trapezoidal in dorsal profile (Fig. 1). Pectoral spines short, virtually straight, and well-armed with numerous small serrae on anterior edge and few large serrae on posterior edge (Fig. 2). Premaxillary tooth patch narrow and slightly curved. Adipose fin long and adnate. Branchiostegal rays 10, rarely 9. Vertebrae 33 in 3, 34 in 5, and 35 in 1 of 9 specimens counted. Preoperculomandibular canal pores usually 11, occasionally 10; mental pores fused in 3 of 27 specimens counted. Infraorbital canal with 7 pores, and never fused anteriorly with supraorbital canal. Anal, caudal, pectoral, and pelvic fin ray counts appear in Table 1. Pelvic fin typically with anterior rudimentary ray (not included in counts). Ratios of measurements used by Taylor (1969, table 26), with that for the holotype followed by the mean and range for 17 specimens (13 Clinch and 4 Duck river) are as follows: tip of caudal fin to adipose notch ratio 1.8, 1.8, 1.7-2.2; predorsal length ratio 1.4, 1.5, 1.3-1.7; head length ratio 1.7, 1.9, 1.6-2.1; caudal peduncle depth in predorsal length 3.9, 3.8, 3.7-4.5; pectoral spine length in predorsal length 3.0, 2.6, 2.2-3.5; dorsal spine length in predorsal length (spine broken in holotype), 5.0, 3.7-6.8. Other measurements, expressed as thousandths of SL, appear in Table 2.

Coloration in preservative: Dorsum of head dark brownish gray except for unpigmented areas surrounding nares and at tip of snout. Dark pigment extends ventrad to base of maxillary barbel and then straight back under and behind eye to middle of cheek, where there is a rounded ventral extension of dark pigment. Ventral border of dark pigment then extends obliquely dorsad to posterior tip of opercular bone. Posterior membrane of gill cover darkened from dorsal margin about halfway to base of pectoral spine. Nasal barbel dark, maxillary barbel with dark base but otherwise unpigmented. Other barbels, and ventral and ventrolateral areas of head immaculate. Dorsum of body dark brownish-gray with broad pale area between occiput and dorsal spine, and with small pale blotches under posterior base of dorsal fin and under anterior and posterior ends of adipose fin. Dark pigment of dorsum extends ventrad to slightly below lateral myoseptum, and extends slightly farther ventrad in areas below dorsal fin and above anal fin. Remainder of ventrolateral and ventral surface immaculate. Dorsal fin with dark pigment covering spine and bases of anterior rays, occasionally with a few flecks of dark pigment at tips of posterior rays. Pectoral fin with dark pigment covering dorsal surface of spine, otherwise immaculate. Adipose fin typically without pigment, but occasionally with a few dark chromatophores near base at middle. Pelvic and anal fins unpigmented. Caudal fin base with dark blotches covering bases of dorsal and ventral procurrent rays and middle 10 to 14 rays. These blotches typically darker than body background pigment. Caudal fin with broad dark subterminal band. Caudal fin pigment present on both rays and membranes.

Coloration in life: Darkest portions of head and body blackish brown. Ground color of middle and upper sides olive brown with faint wash of pale yellow. Lower sides of anterior portion of body (above white belly), lower portion of urosome, and dorsal, adipose, caudal, and anal fins have pale yellowish wash where these parts are not darkened. Pectoral fin, where not dark, is yellowish around spine; remainder of pectoral and all of pelvic fins whitish to clear. Underside of head, chin barbels, and belly white. Eyes distinctly pale blue.

VARIATION.—No meaningful differences in counts, measurements, or pigmentation were noted between Clinch River and Duck River populations. The apparently wider range of certain proportional measurements in Duck River specimens is likely due to the fact that of the four Duck River specimens measured, two were very fresh and the other two had been in preservative longer than any of the Clinch River specimens measured. In the holotype the pale area behind the occiput is less noticeable than in most specimens.

Distribution and habitat

Noturus stanauli is known from two widely separated localities in the Tennessee River drainage. In the Clinch River it has been taken in about half the collections made at the type locality. Most specimens have been taken in a single area along the north bank about 30 m below the most downstream of two bedrock shelves that extend across the river, and just above and at the head end of a prominent bed of water willow *(Justicia americana)*. In this area, substrates are of medium gravel, water depths are typically ½m or less, and current is about ⅓ m/sec. Several specimens have been taken in similar habitats directly across the river along the south bank, and in swifter water adjacent to the water willow bed mentioned above. One specimen was taken about 200 m downstream, near the north bank and below the water willow bed, over fine silty gravel substrate with very little current and a depth of about 10 cm. At the Duck River locality, *Noturus stanauli* has appeared in only about one-fourth of the collections. The former gravel shoal just across and slightly upstream from the mouth of Hurricane Creek produced several specimens over fine gravel substrates, depths of 1 m, and current velocity of about ⅔m/sec. Recent physical changes in flow pattern at this locality have reduced current and allowed considerable silt accumulation. All recent Duck River specimens have been collected along the north bank of the river about 300 m above the mouth of Hurricane Creek over fine gravel substrates with 20-30 cm depths and current velocity of about ⅓ m/sec.

Both of these localities have extremely diverse fish faunas. The Duck River locality, with over 90 known species, shares with the upper Tombigbee River, Mississippi, and the Pearl River near Bogalusa, Louisiana (pers. comm. G. H. Clemmer and R. D. Suttkus, respectively), the distinction of containing the most diverse freshwater fish fauna in North America. The Clinch River localaity contains about 80 species, and probably the most diverse mussel fauna (about 50 species, pers. comm. P. W. Parmalee) remaining in North America. It is interesting to note that the area in Big Darby Creek, Ohio, the only known locality for *N. trautmani*, also contains over 80 fish species (Taylor, 1969), while *N. flavipinnis* (Copper Creek, tributary to Clinch River) and *N. baileyi* (Abrams Creek, tributary to Little Tennessee River) occur (or occurred) in large creek-small river habitats with about 65 fish species. Many of our more enigmatic madtoms are restricted to only the best (most diverse) remaining habitats of warm, large streams and rivers. We know very little about the biology of madtoms, but species of *Ictalurus* are known to be highly evolved social animals dependent upon olfactory cues for coordination of behavioral patterns (Atema et al, 1969; Todd, 1971). We speculate that recent extinction and extirpation (resulting in fragmented distributions) of several species of madtoms may, in addition to visible habitat degradation, be related to their being unable to cope with the olfactory "noise" being added to riverine ecosystems in the form of a wide variety of complex organic chemicals that may occur in only trace amounts.

Biology

We can offer little besides noting that only two age groups are apparent, and that night collections at both localities have actually been less productive for this species than have daytime collections. When collected at the type locality, the pygmy madtom is often associated with *N. eleutherus*.

Status

Because of its extremely limited distribution, *N. stanauli* is being considered for Threatened status by the U. S. Fish and Wildlife Service, Office of Endangered Species. It is listed as Threatened by the Tennessee Wildlife Resources Agency. The controversial Columbia Reservoir project, still under construction about 100 river miles above the Duck River locality, could eliminate this species from that river.

Etymology

The species epithet, *stanauli,* is derived from the Cherokee word for a shoal area in a river, "oostanauli" or "ustanaula", and the Cherokee word for a catfish, "tsulistanauli" (King, 1975).

Anatomical note

Taylor (1969, p 5) noted that an anterior rudimentary pelvic ray was present in both *Ictalurus* and *Pylodictis,* but had "apparently degenerated into a small round ball or disappeared in *Noturus*". The rather consistent presence of this rudimentary ray in *N. stanauli* prompted our examination of other *Noturus* species. Cleared and stained as well as alcoholic specimens of all recognized nominal species except *N. baileyi, N. furiosus, N. placidus,* and *N. trautmani* were examined for this structure. The rudimentary ray noted in *N. stanauli* is very silimar to that seen in *Ictalurus* and *Pylodictis,* and is a slender structure lacking basal articulation, much shorter than the first pelvic ray, and separated from the first ray by a space approximately equal to spaces between other anterior pelvic rays. Within the subgenus *Rabida,* the rudiment was present but very small in one of four pelvic fins of *N. h. hildebrandi,* and one of ten pelvic fins of *N. h. lautus.* In the *elegans* species group the rudiment appeared in four of six pelvic fins in *N. albater,* six of ten in *N. elegans* (present in specimens from the Barren, Duck, and Flint river systems), and four of four pelvic fins in *N. eleutherus.* In the *furiosus* species group it was absent from four pelvic fins of *N. stigmosus,* and occurred as a small round ball in one of eight pelvic fins in *N. munitus.* The rudiment was absent from ten pelvic fins in *N. miurus* and from eight fins in *N. flavipinnis (miurus* species group). In the subgenus *Noturus, N. flavus* had the rudiment in six of twelve pelvic fins. In the subgenus *Schilbeodes* the rudiment appeared as a tiny round ball or small splint in 5 of 14 pelvic fins in *N. gyrinus,* but was absent in *lachneri* (4 fins), *exilis* (6), *insignis* (4), *leptacanthus* (6), *nocturnus* (4), *funebris* (4), *phaeus* (4), and *gilberti* (2). These data support Taylor's (1969) placement of the *hildebrandi* and *elegans* species groups as relatively more primitive (fewer derived characters) than other members of *Rabida.* The placement of *N. (Noturus) flavus* as the most primitive of the madtoms, and *N. gyrinus* as rather remote from other *Schilbeodes* and as the most primitive member of that subgenus is also strengthened. *Rabida* appears to be more primitive than *Schilbeodes* on the basis of this single character.

Literature Cited

Atema, J., J. H. Todd, and J. E. Bardach, 1969. Olfaction and behavioral sophistication in fish. In: Olfaction and taste: proceedings of the third international symposium, C. Pfaffman, editor. Rockefeller Univ. Press, New York, N.Y.

Bailey, R. M., and W. R. Taylor, 1950. *Schilbeodes hildebrandi,* a new ameiurid catfish from Mississippi. Copeia 1950 (1):31-38.

Douglas, N. H. 1972. *Noturus taylori,* a new species of madtom (Pisces, Ictaluridae) from the Caddo River, southwest Arkansas. Copeia 1972(4):785-789.

Hubbs, C. L., and K. F. Lagler, 1958. Fishes of the Great Lakes region. Bull. Cranbrook Inst. Sci. 26:1-213.

King, D. H. 1975. A grammar and dictionary of the Cherokee language. Doct. Dissert., Univ. Ga.:1-294.

Starnes, W. C. and L. B. Starnes, 1978. A new cyprinid of the genus *Phoxinus* endemic to the upper Cumberland River drainage. Copeia 1978(3):508-516.

Taylor, W. R. 1969. A revision of the catfish genus *Noturus* Rafinesque with an analysis of higher groups in the Ictaluridae. U.S. Nat. Mus. Bull. 282:1-315.

Taylor, W. R., R. E. Jenkins, and E. A. Lachner, 1971. Rediscovery and description of the ictalurid catfish, *Noturus flavipinnis.* Proc. Biol. Soc. Wash. 83:469-476.

Todd, J. H. 1971. The chemical language of fishes. Sci. Amer. 224:3-11.

Table 1. Frequency distributions of anal, pectoral, pelvic, and caudal fin ray counts in *Noturus stanauli*. Counts for holotype in boldface.

	Anal fin rays				Pectoral fin rays, both sides counted			Pelvic fin rays, both sides counted			Upper half caudal rays						
	14	15	16	17	7	8	9	7	8	9	22	23	24	25	26	27	28
Clinch River	15	**12**	5	2	2	**63**	3	1	**54**	13	6	11	9	4	3		1
Duck River	2	3	1			9	3		8	4		4		2			
Total	17	15	6	2	2	72	6	1	62	17	6	15	9	6	3		1

	Lower half caudal rays								Total caudal rays													
	22	23	24	25	26	27	28	29	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Clinch River	4	9	**13**	3	4			1	1	5	5	**9**	3	4	5	1						1
Duck River	1	4	1							1	2	1		2								
Total	5	13	14	3	4			1	1	6	7	10	3	6	5	1						1

Table 2. Measurements of *Noturus stanauli* (13 Clinch River and 4 Duck River specimens) expressed as thousandths of standard length.

	Holotype TU 110929	Clinch River $\bar{X}$	Clinch River W	Duck River $\bar{X}$	Duck River W	Total $\bar{X}$
Standard length (mm	36.2	28.4	23.4-36.2	26.3	22.0-29.8	27.9
Adipose notch to tip of caudal	309	312.4	289-332	296.0	262-316	308.6
Body depth	168	175.8	157-192	184.2	158-210	177.8
Caudal peduncle depth	105	104.5	94-116	102.5	88-114	104.0
Snout to dorsal origin	408	386.7	359-413	402.2	389.-420	390.4
Dorsal origin to adipose origin	248	243.1	224-265	243.8	233-261	243.2
Dorsal origin to adipose notch	561	574.8	547-605	571.2	532-595	574.0
Anal origin to caudal base	392	400.0	384-428	399.2	378-433	399.8
Caudal peduncle length	190	202.9	190-221	199.2	191-210	202.1
Highest dorsal ray	157	166.9	157-191	163.0	154-168	166.2
Dorsal spine length	broken	78.5	61-100	79.8	74-92	78.8
Adipose length	309	333.1	309-366	337.8	312-360	334.2
Adipose height	44	43.6	36-53	46.8	33-56	44.4
Caudal length	207	217.0	199-235	210.0	202-215	215.4
Anal base length	204	205.0	188-224	206.5	194-228	205.4
Highest anal ray	141	154.1	127-171	148.0	147-149	152.9
Pectoral length	196	211.7	194-231	213.8	201-235	212.2
Pectoral spine length	135	148.7	119-169	157.5	146-176	151.3
Pelvic length	144	155.2	142-171	152.3	147-156	154.6
Humeral process	50	55.2	46-62	59.2	52-67	56.2
Head length	323	310.5	294-327	304.0	287-323	308.9
Head width	224	229.3	214-250	239.2	213-251	231.6
Head depth at occiput	155	159.2	150-175	154.0	140-177	157.9
Snout length	116	115.5	107-128	113.0	103-128	114.9
Orbit length	75	71.6	64-79	65.5	60-70	70.2
Nasal barbel	80	74.2	64-84	75.2	66-85	74.5
Maxillary barbel	157	147.1	130-161	150.0	135-173	147.8
Outer mental barbel	138	134.3	119-146	148.8	124-173	137.9
Inner mental barbel	102	90.6	76-102	99.5	85-118	92.7