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The Rediscovery of the Mississippi Silverside, *Menidia audens*, in the Pearl River drainage in Mississippi and Louisiana

THE REDISCOVERY OF THE MISSISSIPPI SILVERSIDE, *MENIDIA AUDENS*, IN THE PEARL RIVER DRAINAGE IN MISSISSIPPI AND LOUISIANA

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INTRODUCTION

During the last 28 years, river surveys have been conducted along the upper Pearl River in the vicinity of Monticello, Lawrence County, Mississippi; and for the last 38 years, along the mid-lower section of the Pearl River between Bogalusa, Washington Parish and the town of Pearl River, St. Tammany Parish, Louisiana. The 32 samples per year were taken during the months of February, May, August, and November from the upper Pearl River, and a minimum of 32 samples per year were taken during the months of January, April, July, and October from the 16-km stretch near Bogalusa (Louisiana Hwy 10 crossing, down river to Pools Bluff Sill), Louisiana.

Although our sampling started in 1973 from the upper Pearl River and in 1963 from the lower Pearl River, no *Menidia audens* appeared in our collections until August 30, 1987 at which time a single specimen was taken from along the right bank of the Pearl River, 0.8 km above mouth of Coopers Creek, Lawrence County, Mississippi. An additional 17 specimens were taken between August, 1987 and November, 2001. The purpose of this paper is to discuss the rediscovery of *Menidia audens* in the Pearl River and to provide evidence that *M. audens* is a valid species.

HISTORICAL REVIEW

Hay's (1882) syntypes of *Menidia audens* came from the Mississippi River at Memphis and Vicksburg, from the Big Black River at Edwards, Mississippi, and the Pearl River at Jackson, Mississippi. Suttkus visited the National Museum of Natural History on May 28 and 29, 1985 and examined the syntypes of *Menidia audens*. At that time there were 22 syntypes in all, one from Memphis, 19 from Vicksburg, one from Edwards, and one from Jackson. The specimen from Edwards, Mississippi (USNM 32206), cataloged in September, 1882, (original field No. 156) appeared to be the same specimen that was later cataloged as USNM 32304 in error, on October 16, 1882. This conclusion was based on the fact that both entries mentioned the same field number (156), and the fact that Hay (1882:66) specifically said "one [specimen] from the Big Black at Edwards". Therefore, in our opinion, USNM 32304 was not lost as indicated by Eschmeyer (1998:164).

Our perusal of the literature revealed a somewhat convoluted nomenclatural history for the Mississippi silverside. Hay (1882) enumerated 64 species from the lower Mississippi Valley, five of which he described as new. *Menidia audens* was one of the new species. In a footnote at bottom of page 64 Hay stated, "An abridgment of this description will be found in Jordan and Gilbert's Synopsis Fishes N.A., p. 908". We assume the abridgment was communicated to Jordan because the abridged

description of *Menidia audens* was presented on pages 908-909 in the Addenda et Corrigenda of the Synopsis (1883). The citation was entered as 642(b). *M. audens* Hay, sp. nov., on page 908 and the conclusion, Mississippi River; the types from Memphis and Vicksburg (Hay MSS), appeared on page 909.

Jordan and Evermann (1896:798) presented, in slightly different order, the same abridged description as was presented in the Synopsis. They ended the account with, "Mississippi River; known only from Memphis and Vicksburg". We presume that Hay's (1882) full description of *Menidia audens* was not published in time for Jordan and Gilbert to include in the Synopsis, however it seems likely that the full information would have been available for inclusion or consideration in Fishes of North and Middle America, Part 1 (Jordan and Evermann, 1896). Apparently Jordan and Evermann failed to note that Hay (1882) clearly stated that his type specimens came from the Mississippi River at Memphis (a few) and Vicksburg (many); one specimen from the Big Black at Edwards; and a few from the Pearl River at Jackson.

In his discussion of Hay's types of *Menidia audens* Kendall (1902:259) presented data in tabular form for five specimens from Vicksburg, Mississippi, one specimen from Memphis, Tennessee, and one specimen from Edwards, Mississippi. He said, "all types were small, all but one being young fish". We concur with Kendall's evaluation in that all extant specimens except one are young or juveniles. The one exception is a specimen (65.7 mm SL) in the Vicksburg series. The Memphis specimen (~ 42.0 mm SL) is now partially cleared and some scales are missing.

Nichols (1911:276) examined specimens (= *Menidia audens*) from Moon Lake, Mississippi and could not distinguish them from *M. gracilis* (= *M. beryllina*) from Long Island. Seemingly Nichols' conclusion that both samples represented the same species influenced subsequent authors.

Jordan and Hubbs (1919:51) placed *M. audens* Hay in synonymy under *Menidia beryllina beryllina* (Cope, 1866), citing the following literature: Hay (1882:64); Jordan and Gilbert (1883:908); Jordan and Evermann (1896:798); Kendall (1902:259); and Nichols (1911:276). Then Jordan and Hubbs said, "type-locality. – Memphis, on the lower Mississippi River (now definitely restricted)". This action would infer that Hay's single extant specimen of *Menidia audens* from Memphis should be recognized as the lectotype of *Menidia audens* Hay, 1882.

Apparently neither Jordan nor Hubbs examined Hay's (1882) type material prior to their 1919 publication. It is inconceivable that they would have restricted the type locality to Memphis (Tennessee), where there was only a single young specimen, in deference to Vicksburg (Mississippi) where there were 19 specimens, including one adult. Furthermore, Jordan, Evermann, and Clark (1930:247) again reverted to locality

designation as Memphis, Tennessee, and Vicksburg, Mississippi, for *M. audens* as was given in Jordan and Gilbert (1883) and Jordan and Evermann (1896) without reference to restriction of the type locality to the lower Mississippi River at Memphis by Jordan and Hubbs (1919).

Recent authors (Chernoff et al., 1981:333) and Eschmeyer (1998:164) considered Hay's (1882) extant type material of *M. audens* as syntypes, apparently having overlooked Jordan and Hubbs' (1919:51) action.

One of us (Thompson) reexamined the syntypes of *Menidia audens* in December, 1998. Although accurate counts and measurements were not always possible, and our analysis of the Memphis specimen (USNM 32303) did not agree very well with the counts in Hay's (1882) original description, there is no question that the Memphis specimen is *Menidia audens*. However, the largest specimen in the Vicksburg series conforms reasonably well with Hay's (1882) description. Furthermore, Hay (1882:66) specifically stated that the largest specimen in hand was three inches in total length, and the Vicksburg specimen is the only one that satisfies this total length measurement. We therefore designate the largest specimen (65.7 mm SL) in the Vicksburg series the lectotype of *Menidia audens* Hay, 1882. It will retain the original catalog number, USNM 32308. The remaining 18 specimens (20.4 - 39.0 mm SL) from the same Vicksburg series are herein designated paralectotypes and bear a new number, USNM 351315. The syntypes, USNM 32303 (1, ~42.0 mm SL) from the Mississippi River at Memphis, Tennessee; the syntype, USNM 32206 (1, ~31.3 mm SL) from the Big Black River at Edwards, Mississippi; and the syntype USNM 32307 (1, 25.0 mm SL) (now hard and brittle) from the Pearl River at Jackson, Mississippi are herein designated paralectotypes.

METHODS AND MATERIALS

All samples used in this study were obtained with a 10-ft. (3.05 m) seine, six ft (1.82 m) deep with 3/16-in (0.48 cm) ace mesh. The sampling sites were scattered along a 32-km stretch of the Pearl River in Lawrence County, Mississippi and a 16-km stretch (LA Hwy 10 crossing down river to Pools Bluff Sill) bordering Washington Parish, Louisiana on the west and Pearl River County, Mississippi on the east, near Bogalusa, Louisiana. In addition to this latter 16-km section, we sampled a 64-km stretch from Pools Bluff Sill down river to the Interstate Hwy 59 crossing near the town of Pearl River, Louisiana. During the 16-year (1963-1978) period, 322 fish collections were obtained from this section, with a minimum of 17 and a maximum of 22 collections per year. The sampling was discontinued in 1978 along the 64-km section of river but resumed again in 1990. From 1990 through 1996 another 96 collections were obtained from the same 64-km section, thus a total of 418 collections was obtained during 1963-1996 from this 64-km section.

Thirteen of the 18 specimens of *Menidia audens* were obtained from the upper Pearl River near Monticello, Mississippi and five were obtained from the 16-km section near Bogalusa, Louisiana (Fig. 1). All specimens of *Menidia* taken were preserved and accessioned into the Tulane University Museum

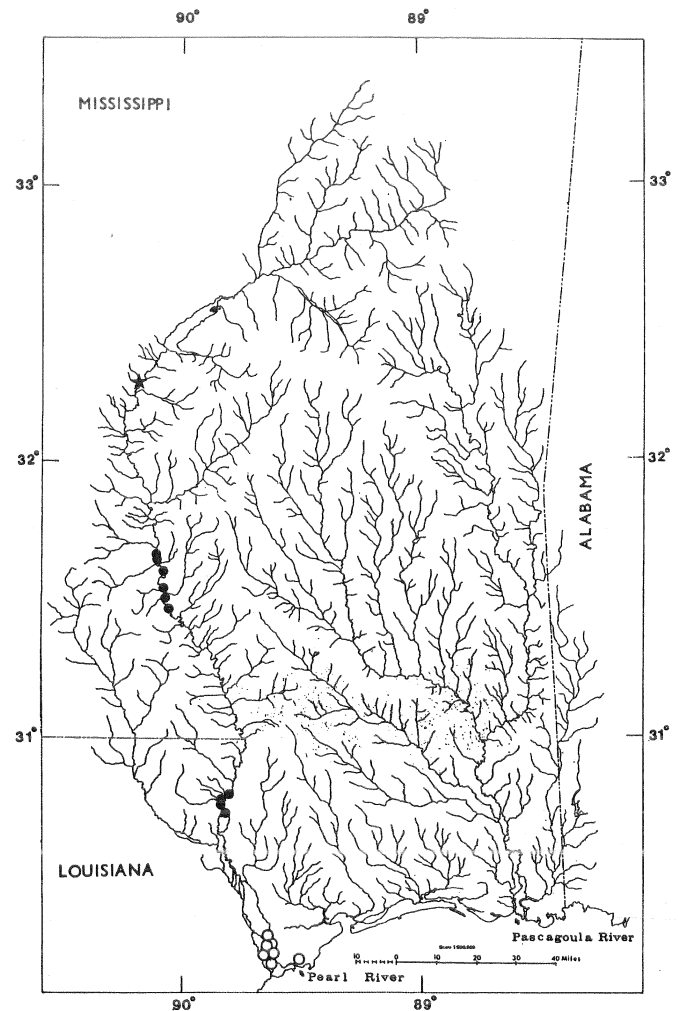


Figure 1. Distribution of the known records of *Menidia audens* and *M. beryllina* from the Pearl River drainage that were used in this study. ★ Syntype locality at Jackson, Mississippi; ● *Menidia audens*; ○ *Menidia beryllina*.

of Natural History (TU). Comparative material of *Menidia beryllina* used in this study was obtained from the extreme lower part of the Pearl River drainage (Fig. 1) where the river is in a braided condition and there are several well established distributaries. This section near the mouth of the Pearl River is approximately 32 km below Interstate Hwy 59 crossing (at the town of Pearl River). Although we did not make salinity determinations the distribution of *Menidia beryllina* in the lower Pearl River (Fig. 1) coincides with the maximum penetration of a salinity wedge reported by Gosselink et al. (1990:71).

Eleven proportional measurements were taken to the nearest 0.1 mm with dial calipers and were expressed in thousandths of standard length (SL) (Table 1). Morphometrics were taken on the 18 *Menidia audens* and 50 *Menidia beryllina* from the series listed below. Pectoral and anal fin ray counts, predorsal and lateral-line scale counts were made on the same specimens mentioned above and additional counts were made on other specimens of *M. beryllina* from the same series (Tables 2 and 3).

Table 1. Measurements in thousandths of standard length for *Menidia audens* and *Menidia beryllina*.

Measurements	<i>Menidia audens</i> (N = 18)			<i>Menidia beryllina</i> (N = 50)		
	Range	Mean	S.D.	Range	Mean	S.D.
Standard length (mm)	22.1 - 68.7	48.3	13.0	48.0 - 60.4	53.8	3.3
First dorsal origin to snout tip	490 - 532	513	10.6	498 - 553	529	13.2
Second dorsal origin to snout tip	634 - 687	657	13.2	650 - 691	664	11.1
Anal origin to snout tip	529 - 566	552	10.8	546 - 600	573	11.7
Pelvic insertion to snout tip	366 - 398	381	9.3	376 - 423	402	10.6
Anal origin to caudal base	438 - 475	454	10.3	409 - 459	436	11.6
Head length	218 - 253	229	9.4	240 - 263	250	6.0
Head depth	116 - 136	127	4.9	130 - 147	138	4.4
Orbit length	68 - 95	77	7.4	72 - 90	83	4.0
Snout length	60 - 81	70	4.7	73 - 88	80	3.3
Body depth	131 - 185	158	12.5	172 - 205	188	7.7
Caudal peduncle depth	68 - 92	78	5.8	83 - 102	91	4.1

Table 2. Frequency distributions for pectoral and anal fin counts in *Menidia audens* and *M. beryllina* from Pearl River drainage.

<u>Meristic Character</u>								
Pectoral fin rays								
Species	12	13	14	15	N	Mean	SD	
<i>M. audens</i>		1	13	3	17	14.1	0.5	
<i>M. beryllina</i>	1	26	60	8	95	13.8	0.6	

Anal fin rays								
Species	15	16	17	18	19	N	Mean	SD
<i>M. audens</i>		2	8	6	2	18	17.4	0.8
<i>M. beryllina</i>	4	16	41	24	10	95	17.2	1.0

Table 3. Frequency distributions for scale counts in *Menidia audens* and *M. beryllina* from Pearl River drainage.

<u>Meristic Character</u>													
Predorsal scales													
Species	14	15	16	17	18	19	20	21	22	23	N	Mean	SD
<i>M. audens</i>							2	8	5	3	18	21.5	0.9
<i>M. beryllina</i>	4	10	49	33	11						107	16.3	0.9

Lateral-line scales													
Species	36	37	38	39	40	41	42	43	44	45	N	Mean	SD
<i>M. audens</i>				2	5	2	2	5	1	1	18	41.5	1.9
<i>M. beryllina</i>	8	28	44	13	2						95	37.7	0.9

Accession numbers, inclusive number of specimens and range of standard length (mm) of specimens used for this study are as follows.

Menidia audens: TU 149792 (1, 43.7), TU 154650 (1, 68.7), TU 157057 (4, 47.1-63.9), TU 160169 (1, 55.8), TU 165657 (1, 39.2), TU 169730 (1, 54.0), TU 184155 (1, 22.1), TU 184261 (2, 30.9-36.1), TU 184752 (1, 54.9), TU 184763 (1, 54.2), TU 184943 (1, 61.1), TU 186155 (1, 54.8), TU 193020 (1, 24.8), and TU 193512 (1, 53.0), (total = 18 specimens).

Menidia beryllina: TU 122491 (3, 45.6-49.6), TU 122561 (62 of 126, 48.0-60.4), TU 122578 (10 of 48, 47.3-60.9), TU 122593 (12 of 17, 46.9-57.4), and TU 122604 (20 of 92, 50.9-59.5) (total = 107 specimens).

RESULTS AND DISCUSSION

The first dorsal, second dorsal, pelvic and anal fins are closer to the tip of snout in *Menidia audens* than in *M. beryllina* (Table 1). The elongate body of *M. audens* is reflected in the less deep head, body and caudal peduncle than in the shorter bodied *M. beryllina*. Some of the *M. audens* used in this study are small juveniles and may have affected the range in variation with regards to some proportions, however position of fins seems to be well fixed early in life of the individual and so our comparisons are probably valid.

Only slight differences exist between *M. audens* and *M. beryllina* in number of pectoral and anal fin rays (Table 2). We realize that we have a limited size sample of *M. audens* from the Pearl River, but our experience with samples of both species from outside the Pearl River drainage indicates a similar overlap in frequencies of number of pectoral and anal fin rays.

Hay (1882) did not report on the high number of predorsal scales, but noted the high number (45) of transverse rows of scales in *Menidia audens*. Moore and Cross (1950) and Moore (1957) emphasized the number of predorsal and lateral-line scales (= transverse rows of Hay) and the slim body of *M. audens*. Certainly, Tables 1 and 3 support Moore (1957). Our findings as presented in Table 3 show a complete separation of number of predorsal scales in *M. audens* and *M. beryllina* from the Pearl River drainage. We suspect and predict that when more specimens become available for analysis that frequency distributions of predorsal scales of the two species will approach each other and probably overlap slightly, however the modes and means will remain separated. Modes and means of lateral-line scale counts also will remain separated.

Hay's (1882) syntype (USNM 32307) from the Pearl River at Jackson, Mississippi had a minimum of 20 predorsal scales and a minimum of 38 lateral line scales.

We conclude that *M. beryllina* (*sensu stricto*) is a brackish water inhabitant and naturally inhabits tidal areas only (Gosselink et al., 1990:71). Furthermore Suttkus and Mettee (1998) found this to be true of *M. beryllina* in the Perdido Bay area of Alabama and Florida. Moreover the many series of *M. beryllina* housed in the Tulane University Museum of Natural History verify this brackish habitat association. Conclusions from this study differ from the views presented by Chernoff et al. (1981) and Chernoff (1982) and we will present a greatly expanded treatment of the *Menidia audens* – *Menidia beryllina* complex in a forthcoming paper.

We believe the data presented herein are sufficient to recognize *M. audens* and *M. beryllina* in the Pearl River drainage as valid species. Neither form was taken from the 64-km stretch between Pools Bluff Sill and Interstate Hwy 59 crossing at the town of Pearl River, even though 418 fish collections were obtained from that section of the river between 1963 and 1996. We suggest that the 64 plus km has functioned as a habitat barrier to the movement of both forms into this intervening area.

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Although the late Dr. Gerald E. Gunning did not participate in the actual collection of specimens of *Menidia audens* from the Pearl River, for the published record, we hereby state our sincere appreciation of his 27 years of participation in the river surveys. We thank John H. Caruso for his help in obtaining our earliest records of *M. audens* from the Pearl River and we thank Jayson S. Suttkus for his help in collecting the remainder of the 18 specimens from the Pearl River. Also for the published record, we make known our belated sincere thanks to the late Dr. Ernest A. Lachner for the many hours of his personal time that he devoted to helping us during our visits to United States National Museum of Natural History. We also extend our appreciation to Susan Jewett at the U.S. National Museum of Natural History for her assistance and expenditure of time to facilitate examination of the syntypes of *Menidia audens*. We thank Henry L. Bart and his staff for the courtesies regarding working space, handling of loans, and retrieval of cataloged data at the Tulane University Museum of Natural History. Also we thank David C. Heins and David A. White for the samples of *Menidia beryllina* they collected from the lower Pearl River and deposited at Tulane University.

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