JUVENILE AND SEX CHARACTERS OF *EVORTHODUS LYRICUS* (FAM. GOBIIDÆ) [1]

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INTRODUCTION

Two species of gobies, which have been recorded from the Gulf coast of the United States and Mexico and which have been placed in separate genera based on characters which were universally accepted by taxonomists as generic, have been found to represent the two sexes of one and the same species. These two species are *Gobius lyricus* Girard and *Evorthodus breviceps* Gill. The latter species has been described from Trinidad, but it also has been reported from the Gulf coast of Mexico by Jordan and Richardson. The author has found it to be quite common in Louisiana. The young, described from Chesapeake Bay, have been placed in still another genus. The female has been named three times, the male independently twice, and the young once.

Full-grown specimens of these two supposedly distinct species are readily separable by the character of the teeth. In *E. breviceps* the teeth are minute, as seen superficially, their distal margins are notched, and they are placed side by side in a single row. In *G. lyricus* the teeth are considerably larger, their margins entire, they are rather widely spaced, and the lower jaw has a row of larger teeth, usually four to six in number, behind the outer row. A band of small teeth has also been described in the lower jaw of the latter species, but this is evidently due to an error of observation. What appears like a band of villiform teeth is really a band of papillæ as has been determined by dissecting out the papilliferous mucous membrane, drying and examining it under a microscope.

During the summer of 1930 while collecting on the coast of Louisiana, the author found these fishes fairly common on Grand Isle and adjacent small islands in Barantaria Bay. Their favorite haunts are small marshy ponds with muddy bottoms, which communicate with the inner larger bodies of water at high tide but are isolated at low tide when they have a depth of about 2 to 4 feet. The remarkable similarity in the appearance of the two nominal species was striking and considering also their constant association, the idea of their being the two sexes of one species came to mind; but in view of the difference in the character of the teeth and the opinions of previous workers, this notion at first was dismissed as untenable. However, a minute examination of the teeth has shown that in many specimens of intermediate size both kinds of teeth occur. This led to an extensive study of the teeth of many individuals, the sex of which was determined by dissection. This study has shown that *Gobius lyricus* is the male and *Evorthodus breviceps* the female of the same species.

[1] Approved for publication, Jan. 23, 1931.

The structure of the teeth, which has been relied on to separate the genera differs radically with the sex and also with age as follows. In the young below 25 millimeters in total length, the teeth are quite small, flattened, proximate, in a single row and their distal edges are apparently entire, at least so far as examination with a binocular microscope discloses. Between 25 and 30 millimeters in length the teeth in both sexes change to those having their distal margins distinctly notched. In the female the single row of notched, small, compressed and proximate teeth remains throughout life. In the male, however, a radical change in the character of the teeth takes place with age. When the young male reaches a length of between 35 and 40 millimeters, two to four enlarged teeth begin to appear in the lower jaw behind the outer row of small teeth. In the larger males this second row of enlarged teeth number as

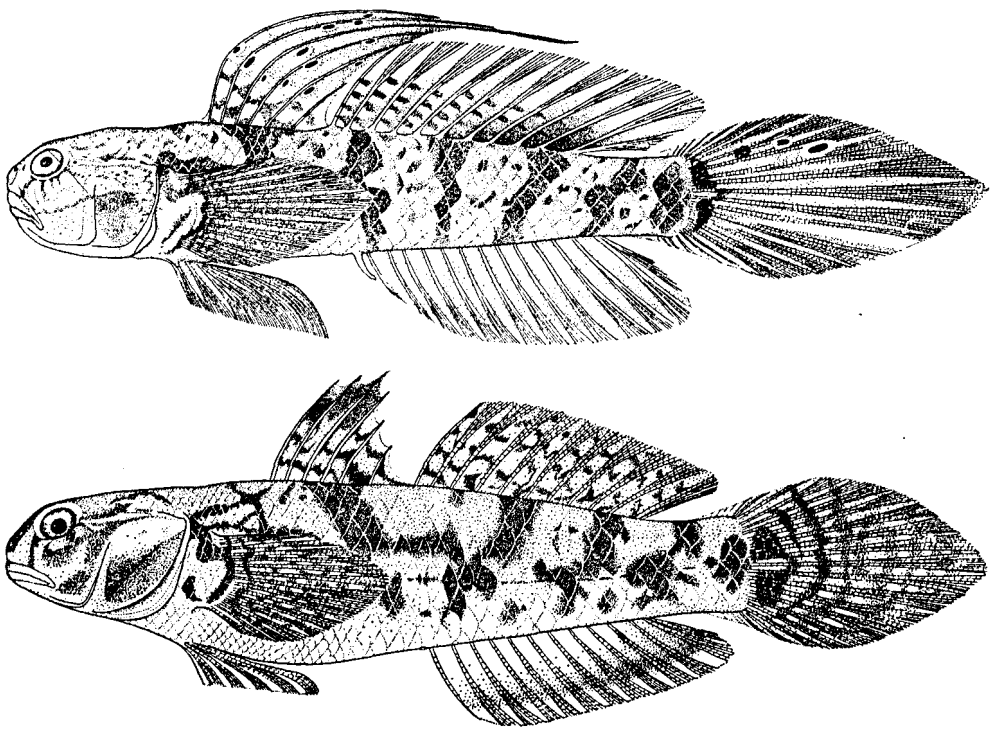

FIGURE 1.—*Evorthodus lyricus*. Upper, mature male; lower, mature female. Drawn by Miss Louella E. Cable from specimens taken on the coasts of Louisiana and Texas

high as 8, the usual number being 4 or 6. The outer row of teeth remains as in the female in specimen up to about 40 millimeters. After the fish exceeds that length they begin to change once more. The teeth become longer and more widely spaced, and their edges are entire. The larger, entire teeth first appear at the symphysis of the upper jaw and gradually spread sideways. The change is gradual; and some small bifid teeth, intercalated with the larger teeth, may be present in males as large as 72 millimeters, although they usually disappear at about 60 millimeters. In the lower jaw the change takes place later, between 55 and 60 millimeters in length. After 72 millimeters in length the teeth become pointed, fanglike as compared with that of the female, and rather widely spaced, so that when full-grown specimens are compared their widely different characters are quite striking.

Not only have the males and females been placed in separate genera, but the young have been described in still another genus. As has been stated above, the very

young have teeth similar to that of the female but with entire edges. The lower jaw is also rather thin and somewhat pointed; and this together with the single row of minute movable teeth, suggests the mouth of a mullet. They have consequently been described under a separate genus, *Mugilostoma*.

The conclusions stated above are based on a study of 86 males, 22 to 79 millimeters in length, and 82 females, 30 to 68 millimeters, from the coasts of Louisiana and Texas. A total of 52 have been dissected, and the sex of the gonads determined by teasing out a small portion and examining with a compound microscope, except in the case of females with well-developed eggs in their ovaries. It might be added that if one wishes to correlate the difference in the teeth with the sex and

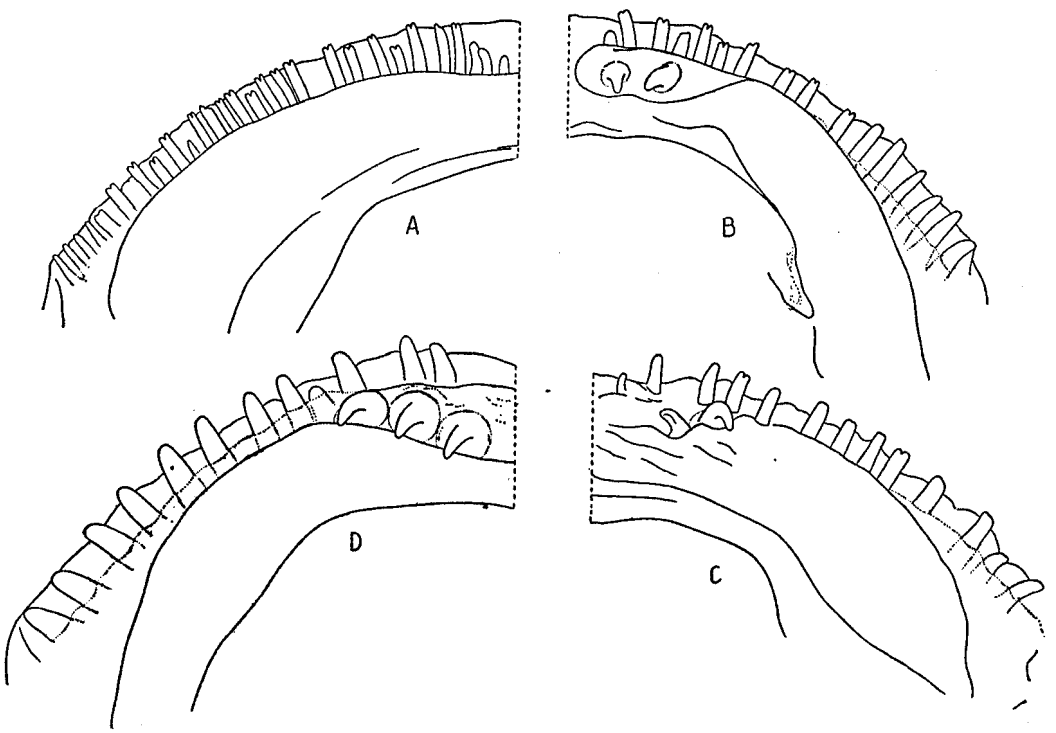

FIGURE 2.—Camera lucida drawing by Miss Louella E. Cable of the inner surface of one side of the lower jaw. A, female 65.5 mm. B, male 60 mm. C, male 67 mm. D, male 69 mm. Note the striking difference, heretofore considered of generic importance, between A and D, and the gradual change in the male from B to D. In the upper jaw of the grown male the teeth are considerably larger than in the lower, and the change in the young male takes place much sooner. The smallest male figured already has the majority of the teeth in the upper jaw typically that of the grown male, and the contrast between the large raptorial teeth and the smaller bifid teeth quite striking

the changes in the character of the teeth in the male, it is not necessary to examine the gonads microscopically since, like in many other gobies, the anal papilla forms an external character usable to separate the sexes readily. In the male the anal papilla is rather long, slender, and pointed, while in the female it forms a fleshy, bulbous tubercle and has a very deep fossa between it and the anal fin. This character readily separates the two sexes, except those of 27 millimeters or less when the difference is usually not marked.

The collections from the Gulf coast have been used to work out the changes due to age and to sex. In order to fix definitely the status of the species and its distribution and to include in the synonymy the various names under which it was previously described from time to time, the following material has been studied.

U.S.N.M. 646. Rio Brazos, Tex. G. Wurdemann. Cotypes of *Gobius lyricus*. The bottle contains seven specimens. The largest one, 77 millimeters total length, is a male of the present species. The other 6 specimens are examples of *Gobionellus boleosoma* (Jordan and Gilbert), 2 females 34 and 41, and 4 males 47 to 52 millimeters total length. Girard, therefore, confused the two species, probably assuming the smaller species to be the young of the larger one; and it becomes necessary to decide to which one of the two species his name is to be applied. Girard's figure is inaccurate and is not characteristic of either species, although it is reasonable to assume that he figured the largest specimen; while the inadequate description may apply to both species. In order to fix definitely the status of the name *lyricus*, the largest specimen is hereby designated as the lectotype.

U.S.N.M. 34456. Trinidad, West Indies. T. N. Gill. A single specimen, type of *Evorthodus breviceps*, in bad condition. It is without doubt a female of the present species. Most of the teeth are gone, but those which remain are distinctly bifid and due to the shrinkage of the soft parts appear longer than in normal specimens and rather hairlike.

U.S.N.M. 87656. Norfolk, Va. Creek and marshes at James Fishery. W. C. Schroeder. Type of *Mugilostoma gobio*. This is a male 27 millimeters total length, not in very good condition. The soft parts around the mouth are shriveled, causing the teeth to stand out prominently and to appear abnormally long as a single row of ciliform teeth. Because of the shriveling the lower jaw also is abnormally thin and angular and this together with ciliform teeth suggests a mulletlike mouth. In color, pattern and other specific characters, it agrees closely with specimens of similar size of the species under discussion. When directly compared with well-preserved specimens the type appears more slender and the ventral fin is placed distinctly in front of the pectoral base instead of under it, but these differences may well be ascribed to its poor state of preservation—the body being evidently shrunken and the wall of the belly collapsed. Most of the teeth are entire, but when examined with a strong lens a few are already seen to be bifid.

Besides the above-described types, other specimens examined were: U.S.N.M. 81823, Cr. Mindi, Canal Zone, January 14, 1911, Meek and Hildebrand, 2 males, 41 and 42 millimeters; U.S.N.M. 78181, Gordo Paint, Nicaragua, March 7, 1917, C. G. Holland, 1 female 74 millimeters; U.S.N.M. 78136, Jamaica, C. B. Wilson, 16 males, 32 to 51 millimeters; U. S. N. M. 88331, Porto Rico, W. C. Earle, 2 males 31.5 and 72.5 millimeters; U.S.N.M. 88301 and 88323, Barranquilla, Colombia, from marshes having connection with Magdalena River, Dr. H. Hanson, February 27, 1924. The label in the last bottle has the name "volador" written on, this apparently being the common name of the fish.

The types of *Gobius garmani* and *Smaragdus costalesi* which are located in the Museum of Comparative Zoology, have been kindly compared by W. C. Schroeder with material from Louisiana, and he finds that the former are females and the latter is the male of the present species. The teeth of *garmani* are notched and in a single row, while that of *costalesi* are entire and the lower jaw has an inner row of enlarged teeth. The coloration and the proportion of the various parts agree closely with the Louisiana material.

As to *Gobius parvus* Meek, the description does not include an account of the structure of the teeth, and is in general quite inadequate. The figure, however, unmistakably shows the characteristic color pattern of the present species, especially

the two black spots on the base of the tail, one above the other and separated by a median area of a lighter color.

In regard to the status of *Gobius wurdemanni* Girard, it seems that no subsequent author has reexamined the type which has been stated to be lost. Jordan and Eigenmann suggested that it "may have been drawn from a female of the same species [*Gobius lyricus*]." Girard's short description quite fits the female of this species, but it may apply just as well to *Gobionellus boleosoma*, which is much more common on the coast of Texas than *lyricus*, or it may apply equally well to *Gobionellus shufeldti*. Since, however, Girard's typical material of *lyricus* included at least six specimens of *boleosoma*, it is evident that he regarded the latter species as the young of *lyricus*. As for *shufeldti*, that species does not appear to be as common. It is, therefore, quite plausible to assume that *wurdemanni* is the female of *lyricus*. At any rate, since the type specimen has been lost and the question can not be positively settled, it is most expedient to let that name rest in peace in the synonymy of *lyricus*, because such action will least disturb the present-day established nomenclature of the American gobies.

EVORTHODUS

Evorthodus Gill, Pr. Ac. Nat. Sc. Philadelphia, p. 195, 1859.

Genotype: *Evorthodus breviceps* Gill=female of *Gobius lyricus* Girard. Monotypic.

Mugilostoma Hildebrand and Schroeder, Fish. Chesapeake Bay, p. 327, 1928.

Genotype: *Mugilostoma gobio* Hildebrand and Schroeder=juvenile of *Gobius lyricus* Girard. Monotypic.

Small gobies with a moderately elongated body. Scales on body rather large, ciliated. Cycloid scales present on upper part of opercle to about the level of the lower margin of the eye. Antedorsal area with smaller cycloid scales extending to eyes; small, partly embedded scales also present on chest and ventral surface of abdomen. Mouth medium, maxillary narrow and weak in both sexes, not quite reaching posterior margin of eye. Caudal fin moderately elongated and pointed in full grown males, shorter and nearly rounded in females and young of both sexes. Teeth in females and young males in a single row, small compressed, notched, proximate; in full-grown males teeth rather long, somewhat pointed, spaced, their distal margin entire, and with a second row of enlarged teeth in lower jaw behind outer row, four to eight in number; the very young having teeth like the females but with entire margins. First dorsal with 6 spines, second dorsal with 11, and anal with 12 rays. Ventral disk well developed, free, infundibuliform. Shoulder girdle without flaps of skin. Tongue free, with entire edge.

EVORTHODUS LYRICUS

Gobius lyricus Girard, Pr. Ac. Nat. Sci. Philadelphia, p. 169, 1858 (Brazos Santiago, Tex., male).

Gobius wurdemanni Girard, Pr. Ac. Nat. Sci. Philadelphia l. c. (Brazos Santiago, Tex.).

Evorthodus breviceps Gill, Pr. Ac. Nat. Sci. Philadelphia, p. 195, 1859 (Trinidad, female).

Gobius lyricus, Girard, U. S. and Mex. Boundary Survey, Part 2, Ichthyology, p. 25, pl. 12, figs. 4–5, 1859 (Texas).

Gobius wurdemanni, Girard, l. c. (Texas).

Smaragdus costalesi Poey, Mem. Hist. Nat. Cuba, **2**: 280 (1856–1858), 1861 (Cuba, male).

Evorthodus breviceps Gunther, Cat. Fish. Brit. Mus., **3**: 85, 1861 (Surinam).

Gobionellus costalesi Poey, Rep. Fis. Nat. Cuba, **2**: 394 (Synopsis) 1868 (Cuba).

Gobionellus costalesi, Poey, Ann. Soc. Esp. Hist. Nat., **5**: 168 (Ennumeratio, p. 126), 1876 (Cuba).

Euctenogobius lyricus, Jordan and Gilbert, Bull. U. S. Nat. Mus., **16**: 633 (1882), 1883.

Gobius lyricus, Jordan and Gilbert, Pr. U. S. Nat. Mus., **5**: 294, 1882 (Galveston, male).

Gobius lyricus, Jordan and Eigenmann, Pr. U. S. Nat. Mus., **9**: 496, 1886.

Gobius garmani Eigenmann and Eigenmann, Pr. Col. Ac. Sci. (2 ser.), **1**: 61, 1888 (Dominica, Fort de France, Martinique, St. Kitts; female).

Gobius lyricus, Eigenmann and Eigenmann, l. c. p. 63 (Cuba; St. Kitts, male).

Gobius lyricus, Evermann and Kendall, Bull. U. S. Fish Comm., **12**: 117 (1894), 1892 (Galveston).

Gobius stigmaticus, Evermann and Bean, Rep. U. S. Fish Comm., p. 247 (1896) 1898. (Indian River Inlet, Fla. Specimen reexamined.)

Gobius parvus Meek, Publ. Field Columb. Mus. Chicago (Zool. ser.), **3**: 121, pl. 31, 1902 (Vera Cruz, Mexico).

Evorthodus breviceps, Regan, Pr. Zool. Soc. London, p. 393, 1906 (Trinidad).

Evorthodus breviceps, Jordan and Richardson, Pr. U. S. Mat. Mus., **34**: 20, fig. 2, 1908 (Tampico, Mexico).

Gobionellus lyricus, Meek and Hildebrand, Publ. Field Mus. Nat. Hist. (Chicago) (Zool. ser.), **15**: 880, 1928 (Mindi, Panama).

Mugilostoma gobio, Hildebrand and Schroeder, Fishes of Chesapeake Bay, p. 327, 1928 (Norfolk, Va., juvenile).

This species of goby is readily recognized in the field as well as in the laboratory by two characteristic dark spots on the base of the caudal fin, one above and one below, separated on the mid line by a yellowish area. These spots are frequently more or less confluent either with each other or with other blotches on the caudal peduncle, but the characteristic pattern is readily recognizable in every case and is present in both sexes at all stages of growth from 15 millimeters and larger (15 millimeters being the smallest specimen examined).

Body elongate; snout obtuse in front; mouth nearly horizontal, subinferior, the upper jaw being longer; gape entirely below level of eye; maxillary extending to vertical through middle or nearly to posterior margin of eye; lower jaw of female rather thin and frequently somewhat angular in front, this character sometimes being rather striking in specimens preserved with their mouths open, or in those having the soft part partly shrunken; the lower jaw heavier and more rounded in the grown male. Caudal fin rather long and pointed in male, shorter and nearly rounded in female; second to fourth rays of first dorsal quite long and filamentous in full-grown male, sometimes nearly reaching the caudal when laid back; only slightly filamentous in female, not reaching past fourth ray of second dorsal; ventral somewhat longer and dorsal and anal somewhat higher in male. Anal papilla in male an elongate pointed flap, in female a fleshy bulbous tubercle. The changes in the structure of the teeth with sex and age described above.

The fundamental color pattern on the body may be stated to consist of a series of six blotches along the mid line of the sides and another series of blotches along the back placed over the interspaces of the median series. All of the blotches are more or less coalescent producing a rather irregular mottled appearance, but in some specimens the two series of blotches may be vaguely discerned; a number of vertical narrow bars frequently more or less distinct on lower half behind vent, in medium sized or large specimen, and are especially well marked in large males. Three or four short oblique streaks below the eye. Two characteristic dark blotches on base of tail, separated by a median yellowish area, as described above. Dorsals, caudal, and pectoral in females and young males streaked with rows of small spots; in large males the spots on the dorsals being fewer, confined to the basal third, more prominent, somewhat larger, and frequently more or less ocellated with white, especially in largest males. Ocellated condition of spots especially marked on first dorsal. First dorsal with irregular black blotches in addition to spots, one blotch on middle extending on back. In full-grown males the caudal becomes uniformly dusky with two longitudinal rose red bands in life, one above and one below the mid line; the upper band usually

having two small black spots one below and a little behind the other. These bands become whitish in preserved specimens. They usually appear in specimens of 40 to 45 millimeters, but are sometimes indistinct even in larger individuals. Anal more or less dusky, especially in males, with a whitish margin. Ventrals plain in females, dusky in males. Base of pectoral marbled with greenish and bluish metallic shades in life, mottled dark in preserved specimens.

The material from Panama, Jamaica, and Porto Rico shows that the chief secondary sexual characters of the male, namely, the elongation of the anterior rays of the first dorsal, the inner band of the teeth in the lower jaw, the unnotched condition of the teeth, the elongate caudal, and the two red bands on the caudal fin, appear when the fish is on the average smaller than those from the northern coast of the Gulf of Mexico. Evidently, the fish matures earlier in tropical waters, but no specific differences have been noted.

This species is known at present from Chesapeake Bay to Surinam. It is quite common on the Gulf coast of the United States and also appears to be common generally throughout the West Indies. It is not now known to be common on the Atlantic coast of the United States, only two specimens having been examined—one from Chesapeake Bay and the other from the Indian River inlet in Florida—but more intensive collecting on the coast of the Southern States may reveal its presence there in considerable numbers. In the author's experience on the coast of Louisiana, while common where it does occur, it was rather localized to a few salt-water ponds. It evidently needs a certain ecological environment for its existence. It was not obtained in seining open beaches. It was found chiefly in two marshy lagoons connected with Barataria Bay, at the east end of Grand Isle and at Rasor Island (the latter is known on hydrographic maps as Queen Bess Island). These lagoons, at low tide, are reduced to mere ponds disconnected from the main body of water. The bottom is muddy. At the first couple of drags of the seine these fishes would not be captured at all or but a few would be taken; but after the water was muddied by dragging the seine back and forth, they would be taken in considerable numbers.

TABLE 1.—*Measurements and counts of Evorthodus lyricus, and E. minutus* [1]

E. LYRICUS

Sex	Total length	Standard length	Depth	Head	Eye	Snout	Maxillary	Inter-orbital	Post orbital part of head	Ante-dorsal distance	Caudal peduncle	Length of ventral	Origin of ventral to anal	Caudal	Spinous dorsal	Soft dorsal	Anal	Scales	Locality
Female	29.5	22.3	20.2	26.9	8.5	5.8	9.9	1.8	15.3	35.0	11.7	22.4	28.7	33.6	6	11	12	-----	Grand Isle, La.
Do	40.2	31.0	24.2	26.5	7.5	7.7	9.7	3.5	15.5	35.5	10.9	21.9	28.4	31.3	6	11	12	-----	Do.
Do	57.0	42.8	26.9	26.2	7.1	7.9	10.8	3.7	14.7	36.2	12.2	25.5	31.5	32.9	6	11	12	32–9	Do.
Do	57	45.0	25.7	25.1	8.0	6.7	9.8	2.2	15.3	35.3	11.8	-----	34.7	-----	6	11	12	-----	Trinidad, West Indies, Type of E. breviceps.
Do	67	50.0	24.8	26.0	7.6	8.0	10.4	4.6	15.2	35.6	12.8	21.0	32.8	33.0	6	11	12	32–10	Grand Isle, La.
Do	71	54.3	21.2	25.0	7.5	7.7	9.8	3.7	13.3	33.1	11.6	22.6	33.0	-----	6	11	12	-----	Indian River, Fla.
Male	27	22.0	17.3	26.8	8.2	5.5	10.5	2.7	15.9	34.1	10.0	20.5	32.7	-----	6	11	12	-----	Norfolk, Va., Type of M. gobio.
Do	35	26.1	19.2	26.4	8.4	7.7	11.1	3.4	15.3	33.0	11.9	24.5	28.7	34.5	6	11	12	-----	Grand Isle, La.
Do	41	29.0	22.4	25.2	8.6	7.6	11.0	3.4	15.5	34.1	11.0	25.2	30.7	42.4	6	11	12	29–10	Mindi, Canal Zone.
Do	45.6	33.4	24.0	26.1	7.8	6.9	9.9	3.3	15.3	33.8	12.3	24.6	28.1	38.3	6	11	12	-----	Grand Isle, La.
Do	56.5	41.4	24.2	26.6	8.0	7.7	11.8	3.4	15.5	34.7	13.3	24.2	29.2	36.7	6	11	12	30	Do.
Do	77.0	57.0	24.6	24.9	7.0	8.4	11.1	3.0	14.4	32.3	12.5	27.2	30.0	35.1	6	11	12	30–9	Rio Brazos, Tex., Type of G. lyricus.
Do	79	56.0	23.3	25.5	6.3	8.9	10.7	4.1	14.8	31.9	12.3	24.6	28.1	41.5	6	11	12	31–10	Grand Isle, La.

E. MINUTUS

Female	30.5	24.3	25.5	24.7	8.6	7.4	9.1	4.1	14.8	37.4	14.0	21.4	30.9	-----	6	11	12	-----	Corozal, Canal Zone, Type of E. minutus.

[1] The numbers given are percentages of the standard length. In the counts of the second dorsal and anal rays, the first single ray was included, while the last two which are invariably approximated at their base have been enumerated as one. The scales have been counted from the upper angle of the base of the pectoral to the base of the caudal and in a transverse row from the origin of the anal backward to the base of the dorsal.

EVORTHODUS MINUTUS

Meek and Hildebrand, Publ. Field Mus. Nat. Hist. (Chicago) (Zool. ser.) **15**: 870, pl. 84, 1928 (Corozal, Panama).

This species has been described from three small specimens obtained on the Pacific coast of Panama. I have reexamined the type, a well-preserved female, 30.5 millimeters long, in the National Museum. It is somewhat chubbier and deeper-bodied than the average specimen of the same size of *lyricus* from the Atlantic coast, but no other essential differences are noted. The teeth have been correctly stated in the original description as being entire, while specimens of that size from the Atlantic coast, as a rule, already have the teeth notched. The determination of the difference in dentition between this species and *lyricus* from the Atlantic coast, if any, as well as the degree of difference in proportional measurements must wait until a series of adults are obtained. The measurements of the type have been included in the above table for the purpose of comparison. No other species of this genus is known at present.