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New species of *Eugerres* from the Usumacinta Province, México and Guatemala with a redescription of *E. mexicanus* (Steindachner, 1863) (Teleostei: Gerreidae)

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Eugerres castroaguirrei, new species is described from the río Grijalva-Usumacinta basin of southeastern Mexico and northern Guatemala. *Eugerres castroaguirrei* and *E. mexicanus* are distinguishable from their marine estuarine congeners by the dorsal-fin origin posterior to the insertion of the pectoral and pelvic fins, a shorter and broad based supraoccipital crest, and a distinct geographic distribution restricted to freshwater habitats. *Eugerres castroaguirrei* differs from *E. mexicanus* by diagnostic characters of the body skeleton: anterior process of supraoccipital convex, infraorbital 1 with foramen, premaxillary ascending process developed with margins curved, pharyngeal plate granular and not serially arranged, and dorsal and anal fin-rays reduced. Likewise, *E. castroaguirrei* is characterized by an oblong and laterally thicker body (37.6-58.5% HL); greater body depth (33.8-42.1% SL), and eye diameter (23.3-31.6% HL); in addition to 16 significant morphometric characters: length of the second dorsal-fin spine 23.2-34.2% SL; depressed second dorsal-fin spine (extending to base of third to fourth dorsal-fin rays); length of second anal-fin spine 11.1-20.6% SL, depressed second anal-fin spine extending to the base of third to fourth anal-fin rays not reaching the distal point of last anal-fin ray; pelvic-fin spine length 49.7-65.0% in the first pelvic-fin ray length.

Eugerres castroaguirrei, es descrita como especie nueva de la cuenca del sistema de ríos Grijalva-Usumacinta, en el sureste de México y norte de Guatemala. *Eugerres castroaguirrei* y *E. mexicanus* se distinguen de sus congéneres marino estuarinos por el origen de su aleta dorsal que es posterior a la inserción de las aletas pectorales y pélvicas, así como por su cresta supraoccipital de longitud corta y base amplia, además de una distribución restringida a ambientes dulceacuícolas. *Eugerres castroaguirrei* se distingue de *E. mexicanus* mediante caracteres óseos diagnósticos como: proceso anterior del supraoccipital convexo, presencia de un foramen en el infraorbital 1, proceso ascendente del premaxilar desarrollado y con márgenes curvos, las placas faríngeas con dientes granulares desarreglados y los soportes de las aletas dorsal y anal reducidos. Asimismo, *E. castroaguirrei* se caracteriza por tener un cuerpo alargado y lateralmente comprimido cuyo grosor representa 37.6-58.5% de la longitud cefálica [LC]; la altura del cuerpo comprendida entre 33.8-42.1% de la longitud patrón [LP] y el diámetro ocular 23.3-31.6 % de la LC; además de 16 caracteres de tipo morfométrico: longitud de la segunda espina dorsal que representa 23.2-34.2% de la LP; segunda espina dorsal que cuando esta plegada se extiende hasta la base del tercer y cuarto radio dorsal; longitud de la segunda espina anal que comprende 11.1-20.6% de la LP; segunda espina anal que plegada se extiende hasta la base del tercer y cuarto radio anal, aunque no alcanza la porción distal del último radio anal; y la longitud de la espina de la aleta pélvica que comprende 49.7-65.0% de la longitud del primer radio pélvico.

Key words: Grijalva-Usumacinta basin, Mexican mojarra, Pichincha, Taxonomy, Vicarious species.

Introduction

The commonly named 'mojarras' of the family Gerreidae comprise a group of fish distributed along the subtropical and tropical coasts areas of the world's ocean. In the Americas, the family consists of 22 valid species, classified in four genera (Nelson *et al.*, 2004): *Gerres* Quoy & Gaimard, 1824; *Diapterus* Ranzani, 1840; *Eucinostomus* Baird & Girard, 1855, and *Eugerres* Jordan & Evermann, 1927. Most of the species inhabit coastal lagoons and estuaries with sandy or muddy bottoms bordered by mangroves; however, they occasionally enter river mouths. It has been thought that *E. mexicanus*, is the only one gerreid species confined to freshwater habitats in the southeastern Mexico and northern Guatemala (Deckert, 1973; Deckert & Greenfield, 1987; Castro-Aguirre *et al*., 1999; Miller *et al*., 2006).

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The amphiamerican genus *Eugerres* includes seven species with serrations on the lower margin of the preopercular and preorbital bones, a characteristic commonly used to distinguish them from other American gerreid genera (*e.g.*, Deckert & Greenfield, 1987; Gilmore & Greenfield, 2002; McEachran & Fechhelm, 2005; Miller *et al*., 2006). Representative species of this genus are distributed along the eastern Pacific: *E. axillaris* (Günther, 1864), *E. brevimanus* (Günther, 1864) and *E. lineatus* (Humboldt, 1821); in the western Atlantic: *E. awlae* (Schultz, 1949), *E. brasilianus* (Cuvier, 1830) and *E. plumieri* (Cuvier, 1830); and in the Coatzacoalcos, Grijalva and río Usumacinta basins in the highlands of southeastern Mexico and northern Guatemala, the vicarious *E. mexicanus* (Steindachner, 1863) (González-Acosta *et al*., 2005, 2007).

González-Acosta (2005) and González-Acosta *et al*. (2005, 2007) have identified phenotypic differences between 'marine-estuarine' and 'freshwater' gerreids based on morphological and meristic studies. A taxonomic review of the Mexican mojarra (*E. mexicanus*) permitted us to identify a differentiated morph from the ríos Grijalva-Usumacinta basin in southeastern Mexico and northern Guatemala which are described here as *Eugerres castroaguirrei* new species.

Material and Methods

Institutional abbreviations follow Sabaj Pérez (2012) with the addition of CIDOAX for the Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional - Instituto Politécnico Nacional, Unidad Oaxaca, Oaxaca, México. Specimens of the new species were critically compared with '*Gerre*'' *mexicanus* syntypes [*sic*] NMW 72289 and NMW 78820 and those of the nominal *E. mexicanus* [*s.l.*] (see material examined section), based on the original descriptions (Steindachner, 1863), comparative examinations, and the taxonomic keys presented by Álvarez del Villar (1950, 1970), Deckert & Greenfield (1987), Castro-Aguirre *et al*. (1999), Miller *et al*. (2006), and González-Acosta *et al*. (2007).

A comparative examination on the skeleton of the freshwater gerreids was conducted to identify the most distinctive bone characters between the species, the examined specimens were prepared by cleared-stained techniques following the procedure of Taylor & van Dyke (1985), and preparing fish skeletons based on Burns & Everly (2000). The results are presented following the body skeleton organization and the bony nomenclature of Rojo (1991), González-Acosta (2005) and Becker *et al*. (2009).

Twenty one linear measurements between external landmark pairs were taken with dial calipers to the nearest 0.1 mm from 157 specimens [125 of *E. mexicanus* and 42 of *E. castroaguirrei*] (Fig. 1). In this analysis, we followed in general the meristic and morphometric methods presented by Hubbs & Lagler (1964) with additions by González-Acosta (2005). Other measurements not included in the Figure 1: interorbital length, third anal spine length, third dorsal spine length, distance between the tips of the second dorsal, and standard length (SL) were also considered.

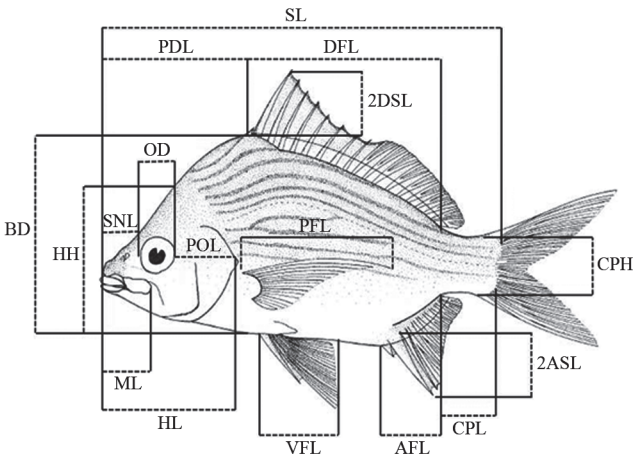

Fig. 1. Body measurements of external morphology used in morphometrics and principal component analysis: anal fin length (AFL); base of dorsal fin length (DFL); body depth (BD); caudal peduncle height (CPH); caudal peduncle length (CPL); head height (HH); head length (HL); maxillary length (ML); orbit diameter (OD); pectoral fin length (PFL); postorbital length (POL); predorsal length (PDL); standard length (SL); second anal spine length (2ASL); second dorsal spine length (2DSL); snout length (SNL); ventral fin length (VFL). Measurements based on González-Acosta (2005). Drawing modified from Bussing (1995). Not included in the illustration: inter-orbital length, third anal spine length, third dorsal spine length and distance between the tips of the second dorsal and second anal spines (SL).

A Student's t-test was used to compare the means of the morphometric proportions. Principal component analysis [PC] was used to examine the variation in morphometric proportions to eliminate the effects of size. The PC analysis was performed on a correlation matrix of log-transformed data, using 20 body measurements (excluding SL) from the external morphology of each specimen. All morphometric data were standardized to remove the size component from the shape measurements and to minimize bias due to variability in standard length, according to Elliot *et al*. (1995). Likewise, measurements were log-transformed to homogenize the variances (Sokal & Rohlf, 1981). Diagnoses and descriptions are given for the taxa included.

Results

In their critical studies of the genus *Eugerres*, Deckert (1973) and Deckert & Greenfield (1987) did not identify meristic or morphometric variations among populations of '*E. mexicanus*' [*s.l.*] from Mexico and Guatemala; they identified to '*E. mexicanus*' [*s.l.*] as the only New World gerreid restricted to freshwater. Recently, González-Acosta (2005) and González-Acosta *et al*. (2007) identified an additional morph (*E.* aff. *mexicanus*) based on an examination of *E. mexicanus* [*s.s.*]

specimens (including type materials) from several localities in their known range of distribution.

Taxonomic analyses conducted on '*Gerres*' *mexicanus* syntypes [*sic*] NMW 72289 (165.6 mm SL) and NMW 78820 (142.8-152.5 mm SL) allowed us confirm the identity of *Eugerres mexicanus* (*sensu* Steindachner, 1863) and distinguish it from the *E.* aff. *mexicanus* morph included in the '*E. mexicanus*' [*s.l.*] complex (González-Acosta *et al.*, 2007), and described herein as *E. castroaguirrei* new species. As well as, morphometric comparisons permit differentiation of two forms as distinct species (Tables 1-2). Thus, *E. mexicanus* can be distinguished by the length of the second dorsal and anal fin spines in relation to the standard and head lengths (Fig. 2a), respectively. Likewise, the depressed second dorsal-fin spine reaches the base of the fifth or sixth dorsal-fin rays and the second anal-fin spine, when depressed extends to distal the point of the last anal-fin ray.

Freshwater species were morphologically different. Proportional measurements (Tables 1-2) indicate that *Eugerres castroaguirrei*, has a moderate orbit diameter and second dorsal and anal spine length; and a longer head, snout, and postorbital length. Thus, the new species differs from *E. mexicanus*, except in terms SL-body depths ratio (Tables 1-2).

Based on the results of the principal components analysis of 20 morphometric variables (excluding SL), the distinction between *Eugerres mexicanus* and *E. castroaguirrei* is largely described by PC-I *vs*. PC-II (Fig. 2b). The variables that loaded most heavily on PC-I (< 50% of the variance) included: body depth, length of dorsal and anal fin bases, postorbital length, head length, interorbital length, head height, pelvic fin length, caudal peduncle height and length, upper jaw length, and snout length (Table 3). Those that loaded most heavily on PC-II included: length of second dorsal and anal-fin spines, and length of third dorsal and anal-fin spines (Table 3).

Eugerres castroaguirrei, new species (Fig. 3a)

Diapterus mexicanus (not of Steindachner). Chávez Lomelí *et al*., 1989: 89 (description). Rodiles- Hernández et al., 1999: 460 (list; distribution) [*in part et non*] *Gerres mexicanus* Steindachner, 1863.

Eugerres mexicanus (not of Steindachner). Rodiles-Hernández, 2005: 204 (list; distribution; ecological notes) [*in part et non*] *Gerres mexicanus* Steindachner, 1863.

Holotype. ECOSC 775, 184.3 mm SL, México, Chiapas, Marqués de Comillas, Lacandona Rainforest, río Lacantún, between Reforma Agraria and Galaxia, 16º14'35''N 90º51'30''W, 25 Mar 1997, R. Rodiles-Hernández.

Paratypes. All collected with the holotype: AMNH 239190, 1, 221.6 mm SL; UABC 2665, 1, 226.3 mm SL; FMNH 117268, 1, 228.5 mm SL; IBUNAM 11436, 1, 213 mm SL; NMW 95100, 1, 202.1 mm SL; and UMMZ 247665, 1, 194.3 mm SL.

Diagnosis. *Eugerres castroaguirrei* is distinct from its congeners (except *E. mexicanus*) by their body oblong and laterally ticker (*vs*. deep and laterally compressed) and the dorsal-fin origin posterior to the insertion of the pectoral and pelvic fins (*vs*. anterior to the insertion of the pectoral and pelvic fins). Differs from *E. mexicanus* by the combination of the following characteristics: length of second dorsal-fin spine 23.2-34.2% SL (*vs*. 18.9-43.3% SL); depressed second dorsal-spine extends to base of third or

Table 1. Morphometric data for Holotype, six Paratypes, and 35 non-type specimens of *Eugerres castroaguirrei*. Standard length, body depth and head length are expressed in millimeters. Numbers in parentheses: mean; SD: Standard deviation.

Eugerres castroaguirrei new species	Holotype	Paratypes	SD	non-type specimens	SD
Standard length	184.3	194.3-228.5 (214.3)	13.7	141.6-241.7 (204.4)	21.2
Body depth	69.8	72.8-84.2 (79.4)	5.1	50.8-89.8 (76.6)	7.3
Head length	60.6	63.2-78.8 (71.0)	5.4	47.3-84.7 (66.9)	7.8
In percent of standard length					
1. Body depth	37.9	36.0-38.3 (37.0)	0.8	33.8-42.1 (37.5)	1.6
2. Distance between the tips of the second dorsal and second anal spines	68.3	57.5-71.1 (64.4)	5.8	55.4-75.4 (65.6)	4.8
3. Head length	32.8	31.4-34.8 (33.1)	1.1	28.2-38.2 (32.7)	1.8
4. Second dorsal spine length	31.1	23.3-29.1 (26.1)	2.1	23.2-34.2 (28.0)	2.9
5. Second anal spine length	17.8	12.7-17.4 (15.2)	1.6	11.1-20.6 (16.4)	1.7
In percent of body depth					
6. Second dorsal spine length	82.0	63.3-81.0 (70.6)	6.3	62.4-88.3 (74.6)	7.1
7. Second anal spine length	45.1	34.4-48.5 (41.0)	4.6	28.0-57.4 (43.7)	4.5
In percent of head length					
8. Second dorsal spine length	94.6	69.4-87.9 (79.0)	6.7	69.5-109.3 (85.7)	9.9
9. Second anal length	52.0	40.3-52.7 (45.8)	4.7	35.1-61.7 (50.1)	5.2
10. Orbit diameter	27.2	24.0-29.6 (27.1)	2.2	23.3-31.5 (27.3)	1.9
11. Snout length	38.2	34.0-38.2 (35.8)	1.6	33.7-50.1 (38.7)	3.8
12. Postorbital length	40.3	40.3-44.3 (42.3)	1.5	38.1-45.8 (41.9)	1.6
Other body proportions					
13. Second anal spine length in anal-fin base length	84.4	73.7-101.9 (90.3)	9.3	67.3-121.9 (95.7)	9.8
14. Second anal spine length in caudal peduncle length	85.2	64.1-90.8 (79.2)	9.8	55.5-111.9 (91.9)	10.8
15. Second anal spine length in second dorsal spine length	55.0	54.0-61.6 (58.0)	3.1	37.3-74.9 (58.8)	6.0

Table 2. Morphometric data for Lectotype, two Paratypes, and 122 non-type specimens of *Eugerres mexicanus*. Standard length, body depth and head length are expressed in millimeters. Numbers in parentheses: mean; SD: Standard deviation.

Eugerres mexicanus	Lectotype	Paralectotypes	SD	Non-type specimens	SD
Standard length	165.7	142.8-152.5 (147.6)	6.8	43.7-193.0 (125.9)	39.8
Body depth	67.0	53.4-60.2 (56.8)	4.8	14.4-74.9 (47.9)	15.8
Head length	50.2	40.6-44.0 (42.3)	2.4	14.1-67.7 (40.4)	13.3
In percent of standard length					
1. Body depth	40.4	37.4-39.4 (38.4)	1.4	31.2-41.9 (37.7)	2.3
2. Distance between the tips of the second dorsal and second anal spines	87.6	87.9-88.2 (88.0)	0.2	63.3-102.1 (81.1)	8.2
3. Head length	30.3	28.4-28.8 (28.6)	0.3	27.7-36.4 (32.0)	1.6
4. Second dorsal spine length	36.9	31.8-34.7 (33.2)	2.0	18.9-43.3 (35.5)	3.9
5. Second anal spine length	21.4	20.0-21.2 (20.6)	0.8	16.7-30.2 (22.3)	2.3
In percent of body depth					
6. Second dorsal spine length	91.4	80.6-92.7 (86.6)	8.5	51.0-118.6 (94.3)	9.6
7. Second anal spine length	52.9	50.7-56.7 (53.7)	4.2	44.6-84.2 (59.2)	7.1
In percent of head length					
8. Second dorsal spine length	122.1	110.2-122.0 (116.1)	8.3	55.4-144.7 (111.3)	14.1
9. Second anal length	70.7	69.2-74.7 (71.9)	3.9	47.8-89.3 (69.7)	8.2
10. Orbit diameter	32.6	33.0-35.5 (34.3)	1.7	26.5-46.3 (34.2)	3.9
11. Snout length	30.3	28.9-30.2 (29.5)	0.9	25.8-43.2 (33.1)	3.3
12. Postorbital length	43.1	43.8-45.3 (44.6)	1.0	35.2-46.2 (41.7)	2.2
Other body proportions					
13. Second anal spine length in anal-fin base length	121.7	110.5-120.0 (115.3)	6.7	95.4-156.3 (121.9)	11.3
14. Second anal spine length in caudal peduncle length	85.9	83.4-91.2 (87.3)	5.5	89.8-152.8 (117.6)	13.6
15. Second anal spine length in second dorsal spine length	57.9	61.2-62.8 (62.0)	1.1	51.8-107.5 (63.0)	6.9

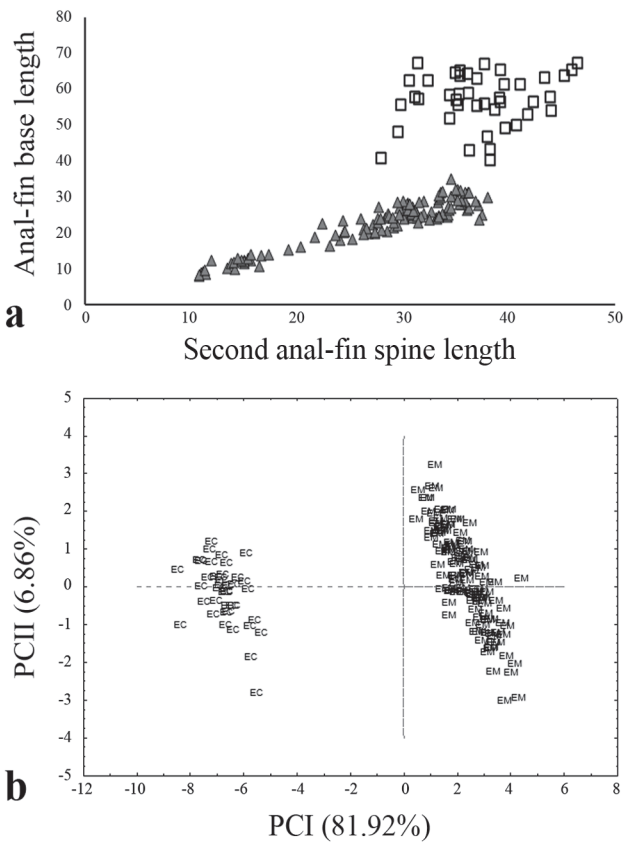

Fig. 2. a) Graphical index for discrimination of *Eugerres castroaguirrei* (squares, n = 42) and *E. mexicanus* (triangles, n = 122), provide by the biplot of second anal-fin spine length against anal-fin base. **b**) Plot of principal components (PC) scores for *E. castroaguirrei* (EC) and *E. mexicanus* (EM) from the southeastern of Mexico and northern Guatemala.

fourth dorsal-fin rays; length of second anal-fin spine 11.1-20.6% SL (*vs.* 16.7-30.2% SL); depressed second anal-fin spine extends to base of third or fourth anal fin-rays and not reaching the distal point of last anal-fin ray; orbit diameter 23.3-31.5% HL (*vs.* 26.5-45.3% SL); pelvic-fin spine 49.7-65.0% SL (*vs.* 42.3-78.2% SL) in the length of first pelvic-fin ray. Lower lips ventrally extending to midpoint of eye (*vs.* ventrally not reaching the anterior margin of eye).

Description. Dorsal-fin rays IX,10; anal-fin rays III,8; pectoral-fin rays iii,12,i; pelvic-fin rays I,5; pored lateral-line (LL) scales 43-51 (mode 46); scales between base of dorsal-fin and LL 3.5-4 (mode 4); scales between LL and anal-fin base 8-9 (mode 9); gill rakers on lower limb of first arch 12-15 (mode 13). Predorsal margin sharply convex. Interorbital space with a wide and central oval depression; premaxillary groove without scales. Maxillary extending to posterior margin of pupil. Dorsal fin origin inserts behind anterior margin of pectoral and pelvic fins; posterior margin of dorsal fin, nearly straight. Second dorsal-fin spine thicker than third dorsal-fin spine, but equal in length. Second anal-fin spine hooked, thicker than third and equal in length. Pectoral fins lanceolate, frequently extend past vent but not reaching the anal fin origin. Caudal-fin deeply forked, lobes equal in length (thicker than in *E. mexicanus*); lower lobe thicker than upper. Mouth protractile and terminal; upper and lower lips enlarged, the lower lips ventrally flattened and extending to midpoint of eye. Pharyngeal teeth granular, serially arranged. Posterior and lower preopercle margins with conspicuous serrations. Lower margins of preorbital 1 and jugal serrated. Subopercular and infraorbital margins frequently serrated. Head covered by small cycloid scales; ctenoid scales on

Table 3. Character loading on principal components I-II for 16 measurements taken on 42 specimens of *E. castroaguirrei* and 125 of *E. mexcanus* from the Grijalva-Usumacinta River Basin. Bold values represent the variables that loaded most heavily on PC-I and PC-II.

Morphometric features	PC I	PC II
Standard length		
Body depth	**0.058573**	0.002153
Head height	**0.055900**	0.008311
Snout length	**0.050334**	0.053506
Orbit diameter	0.047959	0.007944
Postorbital length	**0.056444**	0.027117
Predorsal length	0.035646	0.018372
Distance between the tips of the second dorsal and second anal spines	0.044780	0.046350
Length of dorsal-fin base	**0.058269**	0.006356
Second dorsal spine length	0.037710	**0.188817**
Third dorsal spine length	0.041736	**0.169595**
Caudal peduncle height	**0.054244**	0.005066
Second anal spine length	0.035201	**0.212941**
Third anal spine length	0.041125	**0.148286**
Caudal peduncle length	**0.052042**	0.016911
Length of anal-fin base	**0.056086**	0.002476
Pelvic-fin length	**0.055064**	0.000120
Pectoral-fin length	0.051203	0.004267
Head length	**0.056898**	0.027840
Upper jaw length	**0.054369**	0.037072
Interorbital length	**0.056418**	0.016499

trunk. Morphometric and meristic data are presented in Tables 1 and 4, respectively.

Coloration. Coloration in life specimens yellowish-silver; four dark, wide stripes on sides; lower dark stripes discontinuous (*vs*. 9-11 continuous dark stripes in other *Eugerres* species); dorsal and caudal fins with blackish margins; pectoral, pelvic and anal fins yellowish-white. Ground color on preserved specimens silvery brown back; four well-defined longitudinal dark stripes on sides of the body; belly silver to yellowish-white; ventral stripes not well-defined; fins yellowish to brownish-white; black margin on first dorsal fin.

Size. Largest specimen examined 242.0 mm SL, 312.2 mm TL, and weight 347.0 g (ECOSC 1742).

Sexual dimorphism. Not observed.

Distribution and habitat. *Eugerres castroaguirrei* inhabits the ríos Grijalva-Usumacinta basin in the highlands of Chiapas and Tabasco, Mexico and northern Guatemala (Fig. 4). This species has a sympatric distribution with its congener *E. mexicanus*.

Ecological notes. *Eugerres castroaguirrei* has not yet been studied; thus, biological and ecological data are lacking. Specimens of the new species are fished by local communities and consumed as food. Further studies are necessary to obtain additional data. The holotype was captured using a seine net 90 cm bellow surface in channel with sandy-slime bottom, pH 8.0, conductivity 478 µS/cm, dissolved solids 242 mg/l, dissolved oxygen 6.9 mg/l, and 26 ºC.

Etymology. The name proposed (*castroaguirrei*) honors the late Dr. José Luis Castro Aguirre, who made several important contributions to our understanding of Mexican fish fauna.

Proposed common name. The proposed English common name is "Lacandon mojarra", after its principal area of distribution. The proposed Spanish common name is "mojarra lacandona".

Remarks. Here we establish that *Eugerres castroaguirrei* was a previously overlooked species in the literature on the Family Gerreidae and freshwater ichthyofauna of Central America (*e.g.*, Meek & Hildebrand, 1925; Jordan & Evermann, 1927; Deckert & Greenfield, 1987; Castro-Aguirre *et al*., 1999; Miller *et al*., 2006). The distinctive characters of the new species are based on meristic, morphometric, and osteological analyses (see formal descriptions), comparison of the external morphology with '*Gerres*' *mexicanus* syntypes [*sic*] (NMW 72289 [165.6 mm SL] and NMW 78820 [142.8-152.5 mm SL]), and specimens assigned to the nominal species (see material examined section).

Material examined. México: Chiapas, La Venta-Mal Paso, ECOSC 4560, 1, 171.0 mm SL. Tabasco-Chiapas, río Tulijá, ECOSC 4372, 1, 187.4 mm SL. **México (Chiapas) and Guatemala**, arroyo Negro, ECOSC 1570, 1, 231.6 mm SL. Río Lacanjá-Lacandona Rainforest, ECOSC 641, 1, 203.5 mm SL; ECOSC 694, 1, 199.7 mm SL; ECOSC 704, 2, 141.6-237.4 mm SL; ECOSC 1272, 1, 179.2 mm SL; ECOSC 1411, 1, 220.4 mm SL; ECOSC 1490, 1, 223.6 mm SL. Río Tzendales - río San Pedro mouth, ECOSC 1848, 3, 192.8-223.9 mm SL. Arroyo Cantabal, mouth of río Chixoy, UMMZ 189974, 1, 202.1 mm SL. Reforma Agraria - río Lacantún, ECOSC 110, 2, 188.2-219.5 mm SL. Arroyo El Bravo - río Lacantún, ECOSC 689, 1, 193.7 mm SL. Arroyo El Salado - río Lacantún, ECOSC 2191, 1, 184.6 mm SL. Playón La Gloria - río Lacantún, ECOSC 750, 3, 184.5-

201.9 mm SL. Galaxia - río Lacantún, ECOSC 775, 6, 184.3-228.5 mm SL. Boca Chajul - río Lacantún, ECOSC 1658, 1, 204.2 mm SL; ECOSC 2347, 1, 233.5 mm SL. López Mateos - río Lacantún, ECOSC 1687, 2, 215.8-227.3 mm SL. Playón de la Mula - río Lacantún, ECOSC 1418, 1, 204.3 mm SL; ECOSC 1840, 2, 199.1-222.9 mm SL; ECOSC 2503, 1, 215.0 mm SL. Playón 21 - río Lacantún, ECOSC 2326, 1, 214.1 mm SL. Playa Chavín - río Lacantún, ECOSC 1742, 1, 241.7 mm SL; ECOSC 2170, 1, 181.8 mm SL. El Tigre-Boca Lacantún, ECOSC 1749, 1, 203.3 mm SL. Boca Chajulillo - río Lacantún, ECOSC 2606, 2, 167-195.1 mm SL.

***Eugerres mexicanus* (Steindachner, 1863)**
(Fig. 3b)

Gerres mexicanus Steindachner, 1863: 383 (original description; type locality: Flus [River] Teapa, Tabasco, México).

Diapterus mexicanus (Steindachner). Meek & Hildebrand, 1925: 592, 599 (new combination). Velasco Colín, 1976:124-125 (description; distribution; figure). Gaspar-Dillanes, 1996: 46 (list; distribution). Rodiles-Hernández *et al*., 1999:

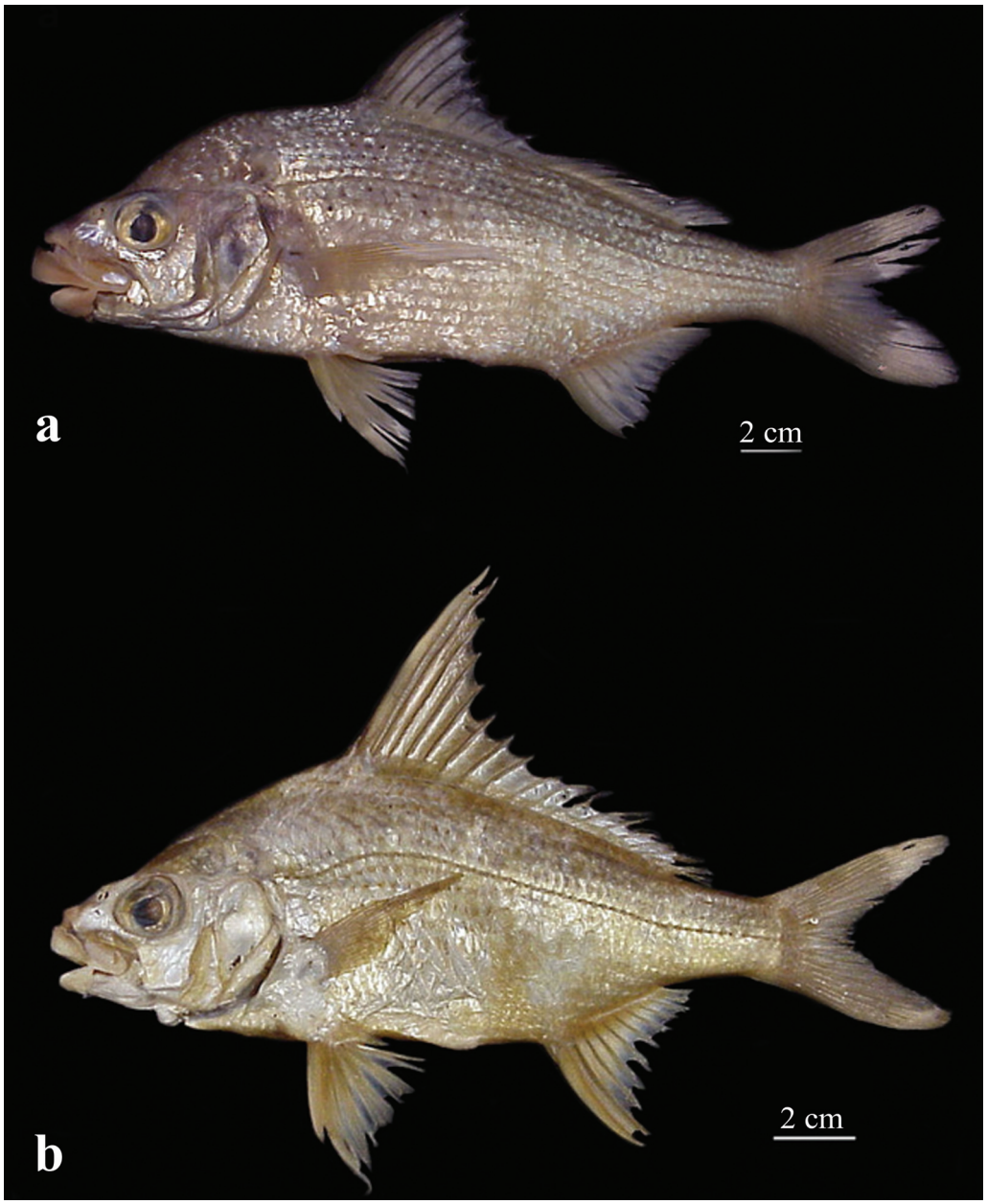

Fig. 3. a) *Eugerres castroaguirrei* new species, ECOSC 775, holotype, 184.3 mm SL. México, Chiapas, río Lacantún, Selva Lacandona, Marqués de Comillas, Reforma Agraria and Galaxia; **b**) *Eugerres mexicanus*, NMW 72289, lectotype, 165.6 mm SL. México, Tabasco, Flus (río) Teapa.

Table 4. Frequency distribution of meristic features of *Eugerres castroaguirrei* and *E. mexicanus* from the Grijalva-Usumacinta River Basin.

	dorsal fin spines (romans) and rays (arabics)				
	IX-9	IX-10	X-10	N	mode
E. castroaguirrei	-	39	-	39	IX-10
E. mexicanus	-	123	-	123	IX-10

	anal fin spines (romans) and rays (arabics)				
	III-8	II-9	III-9	N	mode
E. castroaguirrei	39	-	-	39	III-8
E. mexicanus	120	-	3	123	III-8

	gill rakers on the lower limb of the first branchial arch					
	12	13	14	15	N	mode
E. castroaguirrei	2	20	16	1	39	13
E. mexicanus	7	75	39	2	123	13

	Pored scales on lateral line															
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	N	mode
E. castroaguirrei	-	-	-	-	-	3	1	3	11	8	6	7	-	1	30	46
E. mexicanus	2	5	8	7	9	13	22	13	17	13	9	3	1	-	123	44

460 (list; distribution) [*in part et non*] *Gerres mexicanus* Steindachner, 1863.

Diapterus lineatus (Humboldt). Andreata, 1988: 67 (synon.) [*non*] *Smaris lineatus* Humboldt, 1821.

Eugerres mexicanus (Steindachner). Jordan & Evermann, 1927: 506 (new combination). Deckert, 1973: 35-36, 49-52 (key; distribution; description; figure). Deckert & Greenfield, 1987: 189, 192-193 (key; description; figure). Rodiles-Hernández, 2005: 204 (list; distr.; ecol. notes) [*in part et non*] *Gerres mexicanus* Steindachner, 1863.

Diagnosis. *Eugerres mexicanus* is distinct from their marine estuarine congeners by their body oblong and laterally thicker and the dorsal-fin origin posterior to the insertion of the pectoral and pelvic fins; form its freshwater congener can be distinguished based on the combination of the following characteristics: length of second dorsal-fin spine 18.9-43.3% SL (*vs.* 23.3-34.2% SL); depressed second dorsal-fin spine extends to base of fifth or sixth dorsal-fin rays; length of second anal-fin spine 16.7-30.2% SL (*vs.* 11.1-20.6% SL); depressed second anal-fin spine extends to distal point of

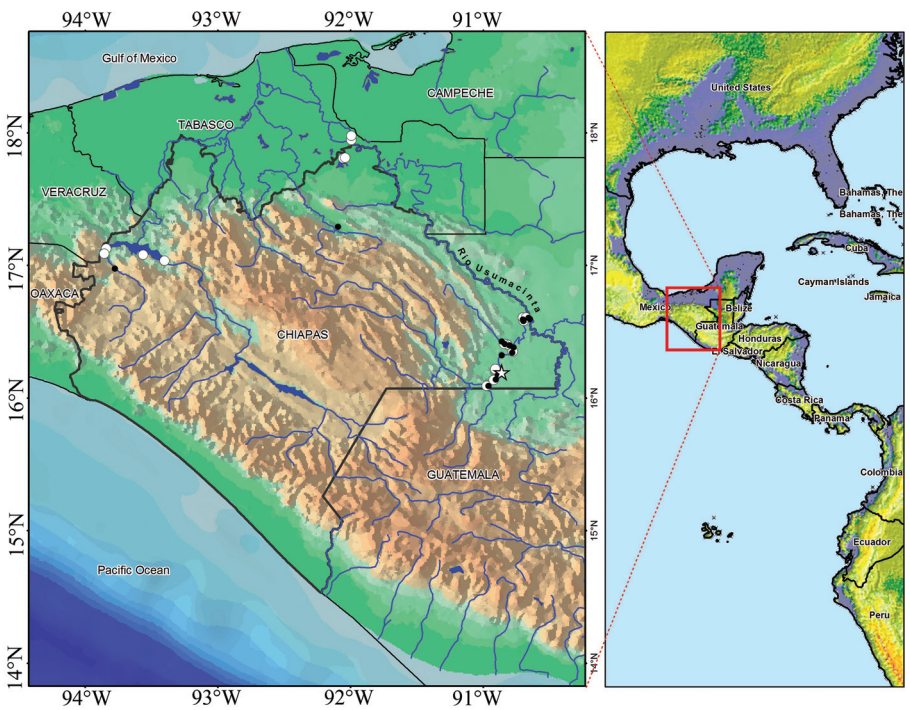

Fig. 4. Distribution of freshwater species of *Eugerres* in drainages along southeastern Mexico and northern Guatemala: *E. castroaguirrei* new species (black dots) and *E. mexicanus* (white dots), type locality (star).

last anal-fin ray; orbit diameter 26.5-46.3% HL (*vs.* 23.3-31.5% SL); pelvic-fin spine length 42.3-78.2% SL (*vs.* 49.7-65.0% SL) in the length of first pelvic-fin ray. Lower lips ventrally not reaching the anterior margin of eye (*vs.* ventrally extending to midpoint of eye).

Description. Dorsal-fin rays IX,10; anal-fin rays III,8 (occasionally III,9; see Table 4); pectoral-fin rays iii,12,i; pelvic-fin rays I,5; pored lateral-line (LL) scales 38-50 (mode 44); scales between base of dorsal fin and LL 3.5-4 (mode 4); scales between LL and anal-fin base 8-9 (mode 9); gill rakers on lower limb of first arch 12-15 (mode 13). Predorsal margin, from snout tip to dorsal-fin origin, gently convex. Interorbital space with slender, central oval depression; premaxillary groove without scales. Maxillary extending to anterior margin of pupil. Dorsal fin origin inserts behind insertion of the pectoral and pelvic fins; posterior margin of dorsal fin, concave. Second dorsal fin spine, thicker than third dorsal spine but equal in length, or a little longer when depressed. Second anal-fin spine thicker, nearly straight (not hooked) and equal in length to third anal-fin spine. Pectoral fins lanceolate, frequently reaching anal fin origin. Caudal-fin deeply forked, lobes equal in length, lower lobe thicker than upper. Mouth protractile and terminal; upper and lower lips enlarged, the lower lips ventrally flattened but not reaching the anterior margin of eye. Pharyngeal teeth granular, irregularly arranged. Posterior and lower preopercle margins with conspicuous serrations. Lower margins of preorbital 1 and jugal serrated. Subopercular and infraorbital margins frequently serrated. Head with small cycloid scales, and with ctenoid scales on rest of body. Morphometric and meristic data are presented in Tables 2 and 4, respectively.

Coloration. Coloration in life based on 26 specimens obtained from Tenosique, Tabasco, México (UABC 2666; MNHN 2006-0767; NMW 95101): body silvery white, brown on back; four dark, thicker stripes on sides; lower stripes dark with irregular pattern; dorsal and caudal fins blackish-white; black margin on first dorsal fin; pectoral, pelvic, and anal fins yellowish-white. Ground color of preserved specimens silvery-black or brown; lateral dark stripes gently convex (sometimes indistinct); belly silvery to yellowish-white; ventral stripes not well-defined; fins yellowish to brownish-white; spinous portion of dorsal fin with black margin.

Size. Maximum size 300.0 mm SL, weight 300.0 to 400.0 g (Velasco Colín, 1976: 125).

Sexual dimorphism. Not observed.

Distribution and habitat. Inhabit freshwater habitats along the ríos Grijalva-Usumacinta, and Coatzacoalcos basins in southeastern México (Chiapas, Tabasco, and Veracruz) and northern Guatemala (Fig. 4). *Eugerres mexicanus* is endemic to the Neotropical region and the Usumacinta Province (Miller, 1966, 1982, 1986; Miller & Smith, 1986; Miller *et al*., 2006), with a noteworthy distribution in highlands with elevations of 100 to 300 m (Castro-Aguirre *et al*., 1999); some of these localities are in Chiapas and the northern part of Guatemala (upper Usumacinta).

Ecological notes. *Eugerres mexicanus* has not been well-studied. However, Collette & Russo (1981) established that '*E. mexicanus*' [*s.l.*] specimens are eaten by *Batrachoides goldmani* Evermann & Goldsborough, 1902, a species with a similar distribution. The Mexican mojarra has omnivorous feeding habits, involving the consumption of insects, plants, crustaceans, and mollusks; and reach sexual maturity at 160.0 mm SL (González-Acosta, 2005). Helminthes parasites of this species had been recently reported (Salgado-Maldonado, 2006). The species is caught abundantly by local fishermen with danger of becoming overexploited. Further studies are necessary to evaluate the potential for aquaculture of this species (González-Acosta, 2005). Additional biological data for this freshwater fish are also necessary.

Common names. *Eugerres mexicanus* is commonly known in English as Mexican mojarra or White mojarra; in Spanish as mojarra mexicana or mojarra blanca; and along the Grijalva-Usumacinta basin as Pichincha.

Remarks. In their critical studies of the genus *Eugerres*, Deckert (1973) and Deckert & Greenfield (1987) did not identify meristic or morphometric variations among populations of '*E. mexicanus*' [*s.l.*] from Mexico and Guatemala; they determined to the White mojarra as the only New World gerreid restricted to freshwater. Recently, González-Acosta (2005) and González-Acosta *et al*. (2007) had identified an additional morph (*E.* aff. *mexicanus*) based on an examination of *E. mexicanus* [*s.s.*] specimens (including type materials) from several localities in their known range of distribution.

Also, Deckert (1973: 51) and Deckert & Greenfield (1987: 192) cited the specimen NMF 72287 [*sic*] as the holotype of '*Gerres*' *mexicanus*. According to the authors this acronym pertains to the Naturhistorisches Museum Fischsammlung. However, NMW staff members have noted that this name and acronym were never employed for the Naturhistorisches Museum Wien [NMW], the name used since 1918 (Herzig-Strachil, 1997: 106). We also confirmed that specimen NMW 72287, 86.3 mm SL, corresponds to '*Gerres*' (*Eucinostomus*) *melanopterus* Bleeker, 1863 from Fernando Po, Western Africa.

In order to clarify the current status of the of *E. mexicanus* type specimens, we followed ICZN (1999) guidelines for named-bearing types (Arts. 72.1.1, 72.3, and 74.1), to invalidate Deckert (1973), and Deckert & Greenfield's (1987) designation of the NMW 722897 specimen as the holotype '*Gerres*' *mexicanus*. In addition, the lectotypes (NMW 72289 and NMW 78820) mentioned by Andreata (1988: 69, 71) are invalidated because the designation does not follow the ICZN guidelines. Based on our critical review of the '*G.*' *mexicanus* syntypes [*sic*], we designate a lectotype (NMW 72289, 165.6 mm SL) and two paralectotypes (NMW 78820, 142.8-152.5 mm SL) of *E. mexicanus*.

Material examined: *Eugerres mexicanus* (Steindachner), Lectotype [designated herein] NMW 72289, 165.6 mm SL (new combination); México, Tabasco, Flus [River] Teapa, 1 Jan 1849, C. Heller. Paralectotypes [designated herein] NMW 78820, 2, 142.8-152.5 mm SL, same data as lectotype. México, Chiapas, Raudales de Mal Paso, ENCB 2523, 1, 121.6 mm SL. Río Mezcalapa, IBUNAM 11713, 3, 43.7-146.2 mm SL. Río La Venta-Presa Mal Paso, ECOSC 47, 3, 182.5-185.3 mm SL; ECOSC 48, 2, 175-185.8 mm SL. Presa Mal Paso-Monte Alegre, ECOSC 303, 1, 190.8 mm SL. Presa Mal Paso-El Encajonado, ECOSC 4441, 2, 181-185.15 mm SL. **México:** Veracruz and Oaxaca: Río Coatzacoalcos, NMW 72290, 1, 149.4 mm SL. Río Chiquito, UMMZ 187699, 28, 17.1-35 mm SL. Arroyo Limones - río del robalo, CIDOAX, 154 1, 114.5 mm SL. México, Tabasco - Chiapas, Tenosique, MNHN 2006-0767, 2, 140.0-163.0 mm SL; NMW 95101, 2, 140.3-144.0 mm SL; UABC 2666, 14, 132.6-170.3 mm SL. Paraíso-Arroyo El Raizal, ECOSC 2394, 3, 146.1-154.6 mm SL; ECOSC 2535, 3, 140.4-157.1 mm SL; ECOSC 2850, 2, 54.4-68.3 mm SL. Laguna Catazajá-Arroyo El Raizal, ECOSC 3622, 1, 125.6 mm SL. La Libertad - río Chacamax, ECOSC 3493, 1, 145.6 mm SL. Laguna Saquilá - río Chacamax, ECOSC 3643, 1, 129.58 mm SL. **México and Guatemala**, Rio Lacanjá-Lacandona Rainforest, ECOSC 380, 1, 140.6 mm SL; ECOSC 398, 7, 140.4-170.4 mm SL; ECOSC 431, 1, 107.9 mm SL; ECOSC 704, 1, 151.1 mm SL; ECOSC 1490, 1, 139.2 mm SL. Río Tzendales-Lacandona Rainforest, ECOSC 587, 1, 180.5 mm SL. Arroyo Jimbal - río Tzendales, ECOSC 2306, 2, 135.4-193 mm SL; ECOSC 2612, 1, 153.6 mm SL. Arroyo El Bravo - río Lacantún, ECOSC 689, 1, 143.5 mm SL; ECOSC 1085, 1, 124.7 mm SL. Arroyo Caribe - río Lacantún, ECOSC 2302, 2, 93.3-105.5 mm SL; ECOSC 2310, 1, 151.5 mm SL. Río Chajulillo, ECOSC 2541, 1, 128.4 mm SL; ECOSC 1659, 1, 65.5 mm SL. Boca de Chajul - río Lacantún, ECOSC 1904, 1, 95.6 mm SL; ECOSC 2606, 1, 167.0 mm SL. Mouth of río Lacantún, ECOSC 1853, 2, 131.5-148.5 mm SL; ECOSC 1860, 1, 82.6 mm SL; ECOSC 2177, 3, 46.2-111.6 mm SL. Arroyo San Lorenzo-mouth of Río Lacantún, ECOSC 2629, 1, 107.3 mm SL. Arroyo Miranda - río Lacantún, ECOSC 2545, 2, 120.8-133.3 mm SL. Pico de Oro - río Lacantún, IBUNAM 5689, 9, 44.4-66.8 mm SL. Río San Pedro (El Petén, Guatemala), UMMZ 143689, 39, 97,0-149.0 mm SL. Río de la Pasión (= Río Chajmaic, Alta Verapaz), UMMZ 143690, 2, 179.8-190.1 mm SL. Arroyo Cantabal, mouth of the Río Chixoy, UMMZ 189974, 14, 82.3-147.9 mm SL.

Comparative material: *Gerres melanopterus* Bleeker, 1863, NMW 72287, 86.3 mm SL, Fernando-Po, West Africa. Col. Corv. Helgol, 18d, 1885 (*sic*).

Osteology of freshwater gerreids

Neurocranium. In the freshwater gerreid species the neurocranium is characterized by a triangular-shaped supraoccipital crest with an anterior process convex and with a broad base, which differs from marine estuarine species where the anterior process of the supraoccipital is right angled or straight with a narrower base (González-Acosta, 2005). The anterior process of supraccipital in *E. mexicanus* is nearly straight (Fig. 5a), whereas *E. castroaguirrei* is convex (Fig. 5b).

The parietal in *E. mexicanus* is bell-shaped, the epioccipital has a short rear projection, the internal crest of the frontal is reduced and the pterosphenoid thinner (Fig. 5a). Whereas in *E. castroaguirrei* the parietal is triangular-shaped, the epioccipital has an expanded rear projection, the internal crest of the frontal is thickened and the pterosphenoid slender (Fig. 5b).

The infraorbital 1 in *E. mexicanus* is trapezoidal-shaped but with the anterior margin almost straight; the ventral margin is somewhat concave and markedly serrated; the caudal process is enlarged and pointed; the dorsal apophysis is dactylar-shaped with a pointed apex; a foramen is absent (Fig. 5c). In contrast, *E. castroaguirrei* has a first infraorbital bone trapezoidal-shaped with their anterior margin rounded; the ventral margin is concave and finely serrated; the caudal process is rectangular and pointed; the dorsal apophysis is blunt; a foramen is present (Fig. 5d).

Branchiocranium. The premaxilla in *E. mexicanus* is slender, presents an ascending process developed with margins almost straight; the articular process is digitiform but with a wide basis, the caudal process is rounded rectangular and the symphysial process is angular and notched (Fig. 6a). In *E. castroaguirrei* the premaxilla is thickened, presents an ascending process developed with margins curved, the articular process is digitiform with a reduced base, the caudal process is markedly rectangular and the symphysial process is rounded without a notch (Fig. 6b).

Marine estuarine species of *Eugerres* are characterized by the presence of molariform-like teeth in the pharyngeal and pharyngobranchial plates (González-Acosta, 2005), condition that differ in freshwater species where the

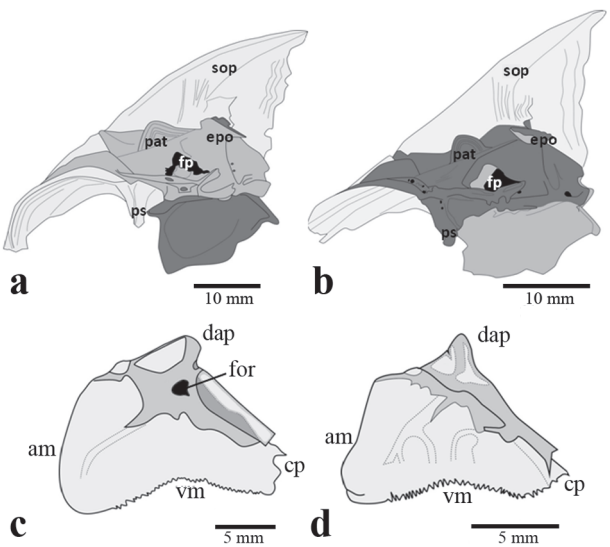

Fig. 5. Lateral view of neurocranium of (**a**) *E. castroaguirrei*, ECOSC 5511-1, and (**b**) *E. mexicanus* UABC 2666. epo = epioccipital, fp = foramen postemporal, pat = parietal, ps = pterosphenoid, sop = supraoccipital process. Lateral view of infraorbital 1 in (**c**) *E. castroaguirrei* and (**d**) *E. mexicanus*. dap = dorsal apophysis, am = anterior margin, cp = caudal process, for = foramen, vm = ventral margin. Both structures from left side.

pharyngeal teeth are granular; in particular, *E. mexicanus* has an irregular arrangement of the dentition in the pharyngeal plates (Fig. 6c), whereas *E. castroaguirrei* is distinguishable by the presence of a dentition serialy arrangement in the pharyngeal plates (Fig. 6d).

Dorsal fin supports. In both freshwater species of *Eugerres*, the first and second dorsal-fin spines are supported by a singular pterygiophore structure, in which the first and second dorsal supports are fused and supported by a proximal radial or first pterygiophore. In *E. mexicanus* the first dorsal spine is small and the second spine long, equaling about 51.7% the pterygiophore length (Fig. 7a); whereas in *E. castroaguirrei*, the first dorsal spine is also small or reduced but the second spine is long, equal to about 55.5% of the pterygiophore length (Fig. 7b).

Anal fin supports. As in the dorsal fin, the first and second anal-fin spines are supported by the apparently fused first and second pterygiophores. In *E. mexicanus* this pterygiophore had a rounded anterior margin and their length comprising 79.4% of the second anal-fin spine length (Fig. 7c). In contrast, the pterygiophore in *E. castroaguirrei* has a rectangular anterior margin and their length is about 97.5% of the second anal-fin spine length, with a rectangular anterior margin (Fig. 7d).

Discussion

The Usumacinta Province, located in the northern part of the Neotropical Region, is characterized by numerous derivatives of marine species adapted to freshwater (*e.g.*, *Batrachoides goldmani* Evermann & Goldsborough, 1902, *Hyporhamphus mexicanus* Álvarez, 1959 and *Strongylura hubbsi* Collette, 1974), with impoverished primary and secondary ichthyofauna. There are numerous low-elevation rivers and lakes along the Atlantic slope characterized by the warmer temperatures found in tropical climates (Miller, 1982). The evolutionary radiation of fish in this region indicates old ichthyofauna with a high degree of endemism at the generic and suprageneric levels (Briggs, 1994).

The discovery of new freshwater taxa is significant and could change our understanding of continental ichthyofauna (Lundberg *et al*., 2007). Examples of this in the area are the endemic 'Chiapas catfish' *Lacantunia*

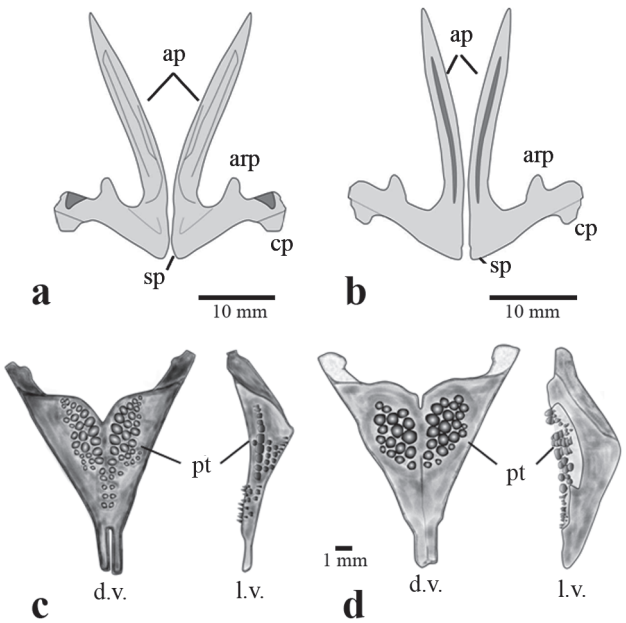

Fig. 6. Premaxillary bone, dorsal view, in (**a**) *Eugerres castroaguirrei* ECOSC 5511-1, and (**b**) *E. mexicanus* UABC 2666. ap = ascending process, arp = articular process, cp = caudal process, sp = symphysial process. Pharyngeal plates in (**c**) *E. castroaguirrei* and (**d**) *E. mexicanus*: dorsal view (d.v.) and lateral view (l.v.). pt = pharyngeal dentition.

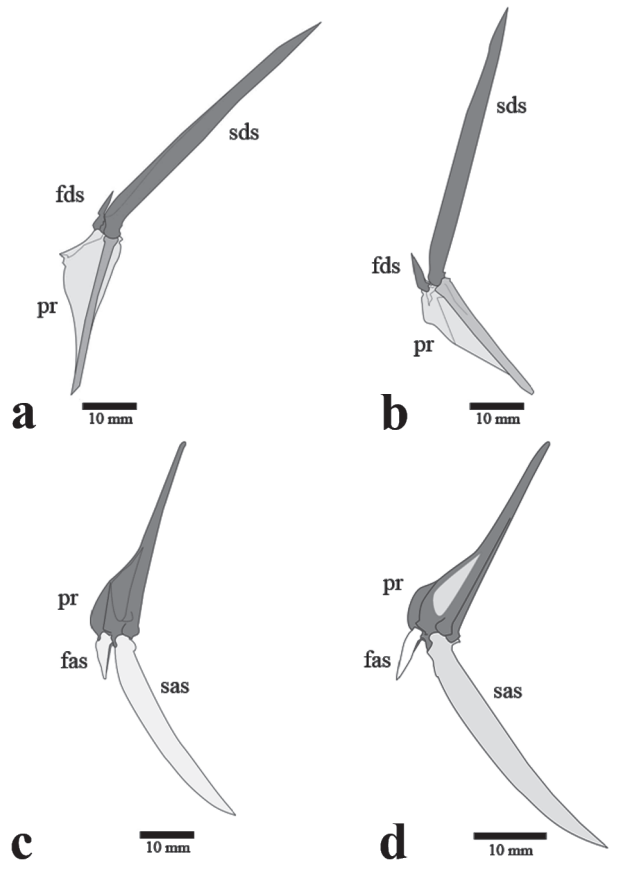

Fig. 7. Dorsal fin supports of (**a**) *E. castroaguirrei* ECOSC 5511-1, and (**b**) *E. mexicanus* UABC 2666. fds = first dorsal spine, sds = second dorsal spine, pr = proximal radial; anal fin supports of (**c**) *E. castroaguirrei* and (**d**) *E. mexicanus*. fas = first anal spine, sas = second anal spine, pr = proximal radial. Both structures from left side.

enigmatica Rodiles-Hernández, Hendrickson & Lundberg, 2005, 'the mojarra from the Ocotal' *Rocio ocotal* Schmitter-Soto, 2007, and 'Usumacinta sea catfish' *Potamarius usumacintae* Betancur & Willink, 2007. Likewise, *E. castroaguirrei* represents a new component of Mesoamerican aquatic fauna, which are characterized by complex and elusive biogeographical and geological histories (Raven & Axelrod, 1979; Savage, 1982). Its discovery has increased the diversity of the fish in the area. The region is negatively affected by the impact of human activities, including the introduction and invasion of exotic species, the destruction of habitats by deforestation, the impact of hydroelectric and agricultural developments on natural drainage basins (Lozano-Vilano *et al*., 2007).

Eugerres castroaguirrei represents the second known vicarious freshwater species of Gerreidae in the New World. The new species is locally sympatric with *E. mexicanus* and shares its distribution with representative species from other families of marine origin [Ariidae: *Cathorops aguadulce* (Meek, 1904), *Potamarius nelsoni* (Evermann & Goldsborough, 1902) and *P. usumacintae*; Batrachoididae: *Batrachoides goldmani*; Belonidae: *Strongylura hubbsi*; Centropomidae: *Centropomus parallelus* Poey, 1860 and Hemiramphidae: *Hyporhamphus mexicanus*].

It has been hypothesized that vicarious species are derivatives fish with marine ancestry that migrated from their original habitat at different times (Lovejoy & Collette, 2001). Studies of molecular characteristics should provide further information regarding genetic distinctions between *E. castroaguirrei* and their relatives, as well as the timing of the divergence of the marine estuarine and freshwater groups.

The comparative analysis based on the osteology of the species supported their taxonomic distinction on the basis of the differential morphology of some bones from several body regions: neurocranium (supraoccipital process), orbitotemporal region (parietal, epioccipital and pterosphenoid), oromandibular region (premaxilla, pharyngobranchial plates), orbital region (infraorbital 1), and the appendicular skeleton (dorsal and anal fin pterygiophores). Differences observed between the bone anatomy of the freshwater group and those reported for marine estuarine species (Andreata, 1988; Andreata & Barbiéri, 1981; González-Acosta, 2005), support the idea to include in further studies to the freshwater gerreid species in a different taxonomic category at genus level (González-Acosta *et al*., 2007).

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