

SHORT COMMUNICATION

## Geographic distribution of *Hemigrammus ora* (Ostariophysi: Characiformes: Characidae) in the Amazon basin, Brazil

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ABSTRACT. New records of *Hemigrammus ora* Zarske, Le Bail & Géry, 2006, previously believed to be endemic to the French Guiana drainages, are confirmed for Brazilian drainages. The species is reported from the Tocantins-Araguaia system and lower Amazon River. Morphometric and meristic data, previously undescribed morphological traits related to caudal-fin squamation and anal-fin hooks, and geographic variation are presented for the species.

KEY WORDS. French Guiana; Tocantins-Araguaia River basin; Guyana shield; Brazilian shield.

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*Hemigrammus* Gill, 1858 (Characidae) is a small tetra genus, comprising 52 valid species inhabiting cis- and trans-Andean drainages in South America (ESCHEMEYER & FRICKE 2011). Recognized as an integrant of the Tetragonopterinae (sensu MIRANDE 2010), *Hemigrammus* is a non-monophyletic entity (MIRANDE 2009, 2010, JAVONILLO *et al.* 2010) whose diagnosis is based on the following set of characters, established by EIGENMANN (1917, 1918) and GÉRY (1977): premaxillary teeth in two rows, five or more teeth on the inner premaxillary row, incomplete lateral line, and caudal fin scaled.

In a recent expedition to the headwater streams of the Araguaia River in the states of Mato Grosso and Goiás, Brazil, specimens of *Hemigrammus* were collected, and after of examination, they were identified as *Hemigrammus ora* Zarske, Le Bail & Géry, 2006. *Hemigrammus ora* is a small characid species originally described from low land rivers in the French Guiana. Material deposited in scientific collections, identified as *Hemigrammus* sp., has revealed that the species was previously collected in some other localities in the Araguaia-Tocantins River basin and other tributaries of the lower Amazon basin.

In this study, meristic and morphometric data were obtained following FINK & WEITZMAN (1974), with the addition of the following features: head depth, measured at the vertical through the posterior tip of the supraoccipital process; dorsal-fin base length; longest anal-fin ray length; anal-fin base length; and dorsal to adipose fin distance, measured from the posterior end of dorsal-fin base to origin of the adipose fin. The measurements, snout and upper jaw lengths, were also taken according to the methodology of GÉRY (1972), following ZARSKE *et al.* (2006), herein emphasized by an asterisk (\*). Measurements were per-

formed with a caliper to the nearest 0.05 mm on the left side of the specimens. Body measurements are presented as percents of standard length (SL), and measurements on the head are presented as percents of head length (HL) and standard length, for comparison with the original description of *H. ora*. Counts of supraneurals, gill rakers on the first branchial arch, branchiostegal rays, vertebrae, and procurrent caudal-fin rays were taken on five cleared and stained (c&s) specimens prepared according to the method of TAYLOR & VAN DYKE (1985). The four vertebrae of the Weberian apparatus and the PU1+U1 of the caudal region were included in the vertebral count. The material examined is deposited in the following institutions: (CAS) California Academy of Sciences, San Francisco, USA; (MCN/FZB) Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil; (MCP) Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; (MNHN) Muséum national d'Histoire naturelle, Paris, France; (UFRGS) Universidade Federal do Rio Grande do Sul, Departamento de Zoologia, Porto Alegre, Brazil; and (USNM) National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

*Hemigrammus ora* was classified by ZARSKE *et al.* (2006) as belonging to the *Hemigrammus ocellifer*-group (sensu GÉRY 1977) based on the presence of humeral and caudal spots (Figs 1-4). From the species of this group, *H. ora* is easily diagnosed by the absence of maxillary teeth (Fig. 5), as well as a short maxilla (7.9-9.7% of SL, range updated) and color pattern. The small humeral spot restricted to the region above the lateral line, a thin lateral band, and the round caudal spot, not reaching the mid-length of the middle caudal-fin rays, is not found in any



Figures 1-4. *Hemigrammus ora* from Tocantins-Araguaia River (1 and 2) and lower Amazon River (3 and 4) basins, showing variation on body height and color pattern on preserved specimens: (1) MCP 44533, 27.6 mm SL; (2) MCP 43631, 35.2 mm SL; (3) MCP 43662, 33.1 mm SL; (4) UFRGS 12077, 31.0 mm SL.

other *Hemigrammus* species (ZARSKE *et al.* 2006). Additionally, ZARSKE *et al.* (2006) quoted as diagnostic of *H. ora* the arrangement of the cusps of the premaxillary teeth of the inner row, in a crescent line; 21 to 24 branched anal-fin rays; 32 to 33 lateral line scales; 10 to 15 perforated scales on the lateral line; body depth 2.94 to 3.44 in SL; and head length 3.42 to 3.96 in SL.

The toothless maxilla found in *H. ora* is an uncommon condition among the species of *Hemigrammus*, as well as its

shape (not illustrated in the original description) (Fig. 5). Most species of *Hemigrammus* have at least one maxillary tooth, and the maxilla is mostly flat along its axis, with a short anterior cylindrical rod-like process medially directed, which is connected through ligaments to the premaxilla and lateral process of the mesethmoid. In *H. ora*, the maxilla is proportionally reduced in length when compared with any other species of *Hemigrammus*. It is cylindrical along most of its axis, and only the posterior portion is lamellar. *Hemigrammus ora* has scales on the caudal fin covering one-third of the dorsal lobe and half length to two-thirds of the lower lobe, a condition found in most species of *Hemigrammus* (see CARVALHO *et al.* 2010, fig. 3b). This feature was not mentioned in the original description, but the presence of caudal fin scales can be noticed in the picture of the paratype (ZARSKE *et al.* 2006: 20, fig. 1).

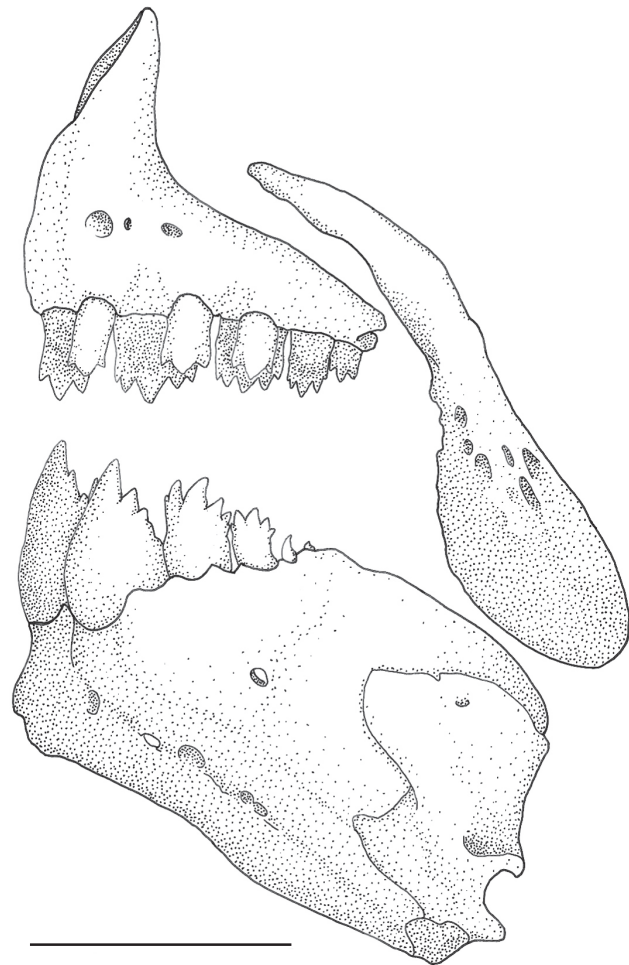


Figure 5. Jaws of *H. ora*, MCP 32623, 30.2 mm SL, left side, lateral view. Scale bar = 1 mm.

Morphometric and meristic data of *H. ora* specimens from the Tocantins-Araguaia Rivers, low Amazon River, and Xingu River basins are presented in Tables I and II. Measurements and counts from these specimens overlap the diagnostic and descriptive data presented in the original description of *H. ora*. The only discrepant value was the snout length\* 7.7-10.6% SL (versus 3.9-7.0% SL). Among the counts, the only information that diverges from the original description is the number of small dentary teeth, posterior to the first four large teeth. Instead of eight to ten small conical teeth, the five cleared and stained specimens presented three small teeth, and in some instances, the tooth just after the first four was tricuspid.

Regarding the presence of hooks on the anal-fin rays, ZARSKÉ *et al.* (2006: 21) briefly mentioned the absence of "hooklets on the first rays of anal fin" of *H. ora*. LIMA & SOUSA (2009) remarked

Table I. Morphometric data of *H. ora*, Amazon system, Brazil. Measures taken according to GÉRY (1972) are followed by an (\*).

Measures	n	Range	Mean
Standard length (mm)	29	24.7–37.2	29.4
Percents of Standard length			
Predorsal distance	29	49.2–54.2	52.0
Prepelvic distance	29	46.7–52.4	49.1
Depth at dorsal-fin origin	29	31.3–39.9	36.2
Dorsal fin to adipose fin distance	29	34.4–38.8	36.8
Dorsal fin to caudal fin distance	29	49.3–54.4	52.0
Eye to dorsal fin distance	29	35.2–40.4	37.9
Dorsal-fin length	29	27.8–33.3	30.0
Dorsal-fin base length	29	13.6–15.5	14.5
Anal-fin length	29	17.0–20.8	18.6
Anal-fin base length	29	28.0–33.4	30.6
Pectoral-fin length	29	16.7–23.0	20.2
Pelvic-fin length	29	16.1–20.2	17.7
Caudal peduncle depth	29	10.9–13.0	11.7
Caudal peduncle length	29	9.4–12.5	11.2
Head depth	29	25.4–30.6	27.8
Head length	29	26.1–30.5	27.7
Snout length	29	7.3–8.8	8.1
Snout length*	27	7.7–10.6	8.9
Upper jaw length	29	7.9–9.7	8.8
Upper jaw length*	27	4.3–5.8	5.1
Orbital diameter	29	8.7–12.2	11.1
Interorbital width	29	8.4–9.5	9.0
Percents of Head length			
Snout length	29	26.5–31.9	29.1
Upper jaw length	29	28.8–35.6	31.6
Orbital diameter	29	30.2–42.7	40.1
Interorbital width	29	30.2–35.1	32.5

Table II. Meristic data of *H. ora*, Amazon system, Brazil.

	n	Range	Mode
Dorsal-fin rays	29	ii, 8–9	9
Anal-fin rays	29	iii, 21–25	24
Pectoral-fin rays	29	i, 9–12	11
Pelvic-fin rays	29	i, 6–8	7
Principal caudal-fin rays	29	18–19	19
Dorsal procurrent rays	5	10–12	12
Ventral procurrent rays	5	9–10	10
Predorsal scales	29	9–11	10
Pored lateral line scales	29	9–15	11
Longitudinal line scales	29	32–35	33
Scale rows above lateral line	29	5–6	6
Scale rows below lateral line	29	3.5–5.0	4
Circumpeduncular scales	29	12–14	14
Maxillary teeth	29	0	0
Premaxillary teeth – outer row	29	3–6	4
Premaxillary teeth – inner row	29	5	5
Dentary teeth	29	4	4
Lower gill rakers	5	10–12	11
Upper gill rakers	5	6–8	6
Branchiostegal rays	5	3–4	4
Supraneurals	5	4	4
Abdominal vertebrae	5	15	15
Caudal vertebrae	5	17–19	18

that they were uncertain about the presence of anal-fin hooks in *H. ora*, due to the fact that their descriptions were based on a few specimens. Herein, the presence of hooks was evidenced on the anal fin of males. Some (up to 28.7 mm SL) have small bony hooks on all branched pelvic-fin rays, and along the lengths of the last unbranched to the eighteenth branched anal-fin rays. The hooks are small, thin, dorsally arched, and their number varies from seven, on the anteriormost ray, to one, on the posteriormost hook-bearing ray. The size and distribution of hooks on the anal-fin rays of *H. ora*, differ from the pattern described by LIMA & SOUSA (2009) to their more restrict "*Hemigrammus ocellifer* species group". LIMA & SOUSA (2009) characterized in this group based on the presence of a single medium-sized hook per anal-fin ray, distributed in the same height of each ray, from the last unbranched to the sixth to seventh branched anal-fin rays. However, the distribution and morphology of the anal-fin hooks in *H. ora* resembles the pattern that LIMA & SOUSA (2009: fig. 6) assigned to *Hemigrammus schmardae* (Steindachner, 1882). Despite the anal-fin hooks, no other sexual dimorphic feature was found in *H. ora*. No gill glands were found on the macroscopic examination of the first gill arch of mature male specimens (BURNS & WEITZMAN 1996).

The specimens of *H. ora* herein examined present two main morphological differences when compared with the type specimens: a lower number of small dentary teeth posterior to the first four large teeth (3 versus 8-10); and a longer snout (7.7-10.6 versus 3.9-7.0% SL\*). Additional material of *H. ora* from the French Guiana was not found in fish collections. Therefore, we were not able to provide a more extensive investigation concerning those differences. In spite of that, the specimens from Brazil fit the diagnosis elaborated by ZARSKÉ *et al.* (2006) based on specimens from the French Guiana, with which they share the color pattern (with distinct humeral and caudal spots), and the morphology of the maxilla, features absent from other species of *Hemigrammus*. Therefore, we consider the previously mentioned differences between the specimens from Brazil and French Guiana as corresponding to geographic variation.

*Hemigrammus ora* was described from specimens from the Pripri Yiyi River, a coastal drainage from French Guiana. It was also recorded for the Sinnamary basin based on the geographical range presented by PLANQUETTE *et al.* (1996) for *Hemigrammus* aff. *schmarda*, a misidentification of *H. ora* (according to ZARSKÉ *et al.* 2006). The species was considered to be putatively endemic to those drainages. The geographic distribution of *Hemigrammus ora* is herein extended to the lower Amazon tributaries, upper Xingu and Tocantins-Araguaia Rivers basins (Fig. 6). Based on

these new records, we hypothesize that the species has a continuous distribution from its type locality in French Guiana to the lower Amazon River tributaries, until the upper Tocantins-Araguaia River basin. This distribution pattern, from the French Guiana low land rivers to the lower Amazon River and some Brazilian Shield rivers, is observed in other freshwater species, such as *Acnodon* spp. (Serrasalminidae), *Brycon falcatus* Müller & Troschel, 1844 (Characidae), *Exodon paradoxus* Müller & Troschel, 1844 (Characidae) (LUCENA & LUCINDA 2004), *Harttia* spp. (Loricariidae), *Hemibrycon surinamensis* Géry, 1962 (Characidae) (BERTACO & MALABARBA 2010), *Hoplias aimara* (Valenciennes, 1847) (Erythrinidae), *Myleus* spp. (Serrasalminidae), *Parotocinclus* spp. (Loricariidae), *Retroculus* spp. (Cichlidae), *Exodon guyanensis* Puyo, 1948 (Characidae), as summarized by VARI *et al.* (2009) and LIMA & RIBEIRO (2011).

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Figure 6. New records of *H. ora* (dots) in Brazil. The type locality of *H. ora* is represented by a star in French Guiana. Each dot may represent more than one locality.

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Appendix. List of examined and comparative material. (mc) Measured and counted material.

#### Material examined

*Hemigrammus ora*. MNHN 2006-0785, holotype, 37.8 mm SL, Pripri Yiyi, French Guiana; MNHN 2006-0786, 14, paratypes, 20.0-38.5 mm SL, same data of holotype. All from Brazil. **Araguaia River basin**: MCP 34609, 1 mc, 27.5 mm SL, córrego Gengibre, rio São João, rio das Mortes, Ribeirão Cascalheira, Mato Grosso, 12°58'57"S 51°36'58"W, T.P. Carvalho & G.S. Carvalho, 28 Jul 2003. MCP 35453, 1, 25.0 mm SL, rio dos Patos, affluent of rio das Mortes, Ribeirão Cascalheira, Mato Grosso, 12°52'52"S 51°09'36"W, T.P.

Carvalho & G. S. Carvalho, 28 Jul 2003. MCP 40553, 6, 16.9-25.5 mm SL, rio Salobro, Porto Alegre do Norte, Mato Grosso, 10°52'11"S 51°37'48"W, J.F.P. da Silva & L. Cotrim, 21 Apr 2006. MCP 44533, 5 mc, 25.5-27.6 mm SL, ribeirão Santana, Vila Rica, Mato Grosso, 09°49'11"S 51°03'21"W, J.F.P. da Silva & L. Cotrim, 23 Apr 2006. MCP 45500, 2, 27.4-29.9 mm SL, stream at highway BR-158, 61 km South of Porto Alegre do Norte, Mato Grosso, 11°22'28"S 51°39'42"W, J.F.P. da Silva, 28 Oct 2005. MCP 45519, 5, 25.8-27.7 mm SL, córrego em Araguapaz, Goiás, 15°01'41"S 50°48'30"W, F.L.T. Garro, 10 Jun 2008. UFRGS 11622, 23, (3 c&s, 26.9-29.1 mm SL), 26.4-34.2 mm SL, ribeirão Corrente, Barra do Garças, Mato Grosso, 15°29'53"S 52°12'05"W, P.S. Venere, F.C.Jerep, V.A. Bertaco & F.R. Carvalho, 10 Oct 2009. UFRGS 11625, 22, 17.3-22.9 mm SL, ribeirão Corrente, Barra do Garças, Mato Grosso, 15°29'53"S 52°12'05"W, P.S. Venere, F.C.Jerep, V.A. Bertaco & F.R. Carvalho, 10 Oct 2009. UFRGS 12077, 37, (9 mc, 24.7-32.5 mm SL), 9.9-32.5 mm SL, córrego Capivara, Aragarças, Goiás, 15°54'35"S 52°05'35"W, F.C. Jerep, F.R. Carvalho & V.A. Bertaco, 5 Feb 2010. **Tocantins River basin:** MCN 18934, 11, 25.0-30.0 mm SL, marginal pool in right margin of Tocantins River, São Pedro da Água Branca, Maranhão, 05°20'02"S 48°36'57"W, A.R. Cardoso *et al.*, 17 Sep 2010. MCP 40886, 3 mc, 29.9-33.1 mm SL, canal Chamada, córrego da Prata, Porto Nacional, Tocantins, 10°20'15"S 48°22'33"W, J.F.P. da Silva, May 2005. MCP 40901, 9, 10.7-22.9 mm SL, banhado Tartaruga, Porto Nacional, Tocantins, 10°28'44"S 48°22'38"W, J.F.P. da Silva, Jun 2005. **Low Amazon tributaries:** MCP 43631, 2 mc, 35.0-35.1 mm SL, igarapé Pirativa, Macapá, Amapá, 00°13'14"N 51°21'45"W, J.F.P. da Silva & L. Cotrim, 13 Jul 2008. MCP 43662, 4 mc, (1 c&s, 30.3 mm SL), 30.3-37.2 mm SL, rio Palma II, affluent of rio Matapi, Macapá, Amapá, 00°13'40"N 51°11'27"W, J.F.P. da Silva & L. Cotrim, 13 Jul 2008. **Xingu River basin:** MCP 32078, 3, 32.3-35.4 mm SL, rio von den Steinen, Nova Ubiratã, Mato Grosso, 12°41'5"S 54°40'49"W, R.E. Reis *et al.*, 29 Jan 2002. MCP 32623, 6, (5mc, 28.2-30.1 mm SL, 1 c&s, 28.2 mm SL), 21.6-30.8 mm SL, rio Azul, Cláudia, Mato Grosso, 11°28'20"S 54°59'40"W, R.E. Reis *et al.*, 28 Jan 2002.

#### Comparative material

*Hemigrammus armstrongi* Schultz & Axelrod, 1955 (synonym of *Hemigrammus rodwayi* Durbin, 1909), USNM 163868, holotype, 18.7 mm SL, Georgetown, British Guiana, Axelrod, Oct 1954; USNM 163869, 20, paratypes, 15.9-25.7 mm SL, Georgetown, British Guiana, Axelrod, Oct 1954. *Hemigrammus brevis* Ellis, 1911, MCP 17068, 150 (47 examined), 11.6-20.2 mm SL, Brazil, Bahia, Guanambi, rio Olaria. *Hemigrammus marginatus* Ellis, 1911, MCP 43324, mm SL, 483 (6 examined), 21.2-31.5 mm SL, Brazil, Rio Grande do Norte, Parnamirim, rio Pitimbu. *Hemigrammus matei* Eigenmann, 1918, CAS 44436, holotype, 33.7 mm SL, "Argentina?", Patagonia. *Hemigrammus rodwayi*, CAS 121915, 5, paratypes, 30.8-44.5 mm SL; USNM 66188, 5, paratypes, 29.9-35.3 mm SL, Georgetown Trenches, British Guiana, Eigenmann, Sep to Dec 1908; USNM 121839, 8, 20.0-26.9 mm SL, carriera Zila Eau Saumatra, French Guiana, S. Yolles, Mar 1945; USNM 121840, 2, 23.9-25.4 mm SL, Banduel near Cayenne, French Guiana, S. Yolles, Mar 1945. *Hemigrammus tridens* Eigenmann, 1907, CAS 58609, holotype, 17.7 mm SL, Paraguay, arroyo Pypucu; UFRGS 9682, 50 (16 examined), 14.5-21.6 mm SL, Paraguay, San Pedro, rio Aguaray at bridge on highway, 2.1 km North of junction with road to Capitan Bado.