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A new species of *Charax* (Ostariophysi, Characiformes, Characidae) from northeastern Brazil

Erick Cristofore Guimarães[1,3], Pâmella Silva De Brito[2,3], Beldo Rywllon Abreu Ferreira[1], Felipe Polivanov Ottoni[1,2,3,4]

1 *Universidade Federal do Maranhão, Departamento de Biologia, Programa de Pós-Graduação em Biodiversidade e Conservação. Av. dos Portugueses 1966, Cidade Universitária do Bacanga, CEP 65080-805, São Luís, MA, Brasil*

2 *Universidade Federal do Maranhão, Departamento de Biologia, Programa de Pós-Graduação em Biodiversidade e Biotecnologia da Amazônia Legal. Av. dos Portugueses 1966, Cidade Universitária do Bacanga, CEP 65080-805, São Luís, MA, Brasil*

3 *Universidade Federal do Maranhão, Laboratório de Sistemática e Ecologia de Organismos Aquáticos, Centro de Ciências Agrárias e Ambientais, Campus Universitário, CCAA, BR-222, KM 04, S/N, Boa Vista, CEP 65500-000, Chapadinha, MA, Brasil*

4 *Universidade Federal do Maranhão, Programa de Pós-Graduação em Oceanografia. Av. dos Portugueses 1966, Cidade Universitária do Bacanga, CEP 65080-805, São Luís, MA, Brasil*

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Corresponding author: *Erick Cristofore Guimarães* (erick.ictio@yahoo.com.br)

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Abstract

Charax awa sp. n. is herein described from the Rio Mearim, Rio Munim and Rio Turiaçu basins, three coastal river basins of northeastern Brazil located between the Rios Gurupi and Parnaíba basins. These have a complex and still poorly known biogeographic history. This region is ecologically extremely relevant since it comprises three of the main Brazilian biomes, as well as, transition zones between them: Amazônia, Brazilian Cerrado and Caatinga. Therefore, this area has faunal and floristic representatives of these three biomes, which makes it particularly relevant in terms of ecology, biodiversity and conservation. *Charax awa* sp. n. possesses a relatively small orbital diameter (22.1–28.5 % HL), what distinguishes it from most of its congeners, except from *C. notulatus* and *C. caudimaculatus*. It differs from *C. caudimaculatus* by a longer snout, and from *C. notulatus* by the number of scales around the caudal peduncle, as well as by the number of vertebrae. The new species herein described differs from its geographically closely distributed congeners, *C. leticiae*, *C. niger*, and *C. pauciradiatus* mainly by the relative horizontal orbital diameter. It is a "small-eyed" species. In addition, *C. awa* sp. n. can be distinguished from *C. leticiae* by having a maxilla extending to the vertical line posterior to the pupil, near the posterior orbital margin and by having a lower humeral spot distance. It can be distinguished from *C. pauciradiatus* by more scale rows from the pelvic-fin origin to the lateral line and more scale rows from the dorsal-fin origin to the lateral line and it differs from *C. niger* by having more transverse scale rows in space from the humeral spot to the supracleithrum. In addition, it differs from *C. pauciradiatus* and *C. niger* by the absence of bony hooks on anal and pelvic-fins rays of adult males.

Introduction

Characidae is the most species-rich family of Characiformes, comprising about 165 genera and more than 1.150 species, distributed along the river systems between southwestern Texas and Mexico in North America and Patagonia in South America (Nelson et al. 2016; Eschmeyer et al. 2017). *Charax* Scopoli, 1777 is a South American characid genus possessing a midsized (maximum size about 130.0 mm SL) and deep body, being the type genus of the Characidae, comprising 16 valid species (Menezes and Lucena 2014), widely distributed in the Cis-Andean region, occurring in the Amazonas, Paraná, Uruguay, Paraguay, Capim, and Orinoco river basins, as well as in

smaller isolated river basins draining the Guiana Shield, and in the Lagoa dos Patos system, and other coastal lagoons of southern Brazil (Menezes and Lucena 2014).

The distribution of the genus is mainly concentrated in central and northern South America; there is no record for eastern Brazil and none of the valid species was assigned for the coastal river basins of northeastern Brazil by the recent taxonomic revision of the genus (see Menezes and Lucena 2014). However, some records of *Charax* for the coastal river basins of northeastern Brazil were made before the taxonomic revision made by Menezes and Lucena (2014): Martins and Oliveira (2011) recorded *C. gibbosus* for the Rio Mearim basin; Barros et al. (2011) recorded *Charax* sp. for the Rio Itapecuru basin; Martins and Oliveira (2011) recorded *Charax* sp. for the Rio Pericumã basin and Rio Mearim basin.

Charax can be distinguished from all other characid genera by the presence of a deep concavity on the latero-ventral portion of the cleithrum originating a relatively long posterior spiniform projection extending below pectoral-fin base; and an anterior shorter process oriented straight forward or either inclined or bent laterally (Lucena 1987, Mattox and Toledo-Piza 2012: fig 34, Menezes and Lucena 2014). A new species of *Charax* is herein described from the Rio Mearim, Rio Munim and Rio Turiaçu basins, three coastal river basins of northeastern Brazil.

Material and methods

Counts and measurements were taken according to Fink and Weitzman (1974), Menezes and Weitzman (1990) and Menezes and Lucena (2014), on the left side of specimens whenever possible, using a digital caliper with precision of 0.01 mm. Measurements are given as a percentage of standard length (SL), except for subunits of the head, which are given as a percentage of head length (HL). Vertebrae of the Weberian apparatus were not included in the vertebral counts, whereas the fused PU1+U1 of the caudal region was counted as a single element. Counts for supraneurals, vertebrae, rib pairs, branchiostegal rays, gill-rakers, premaxillary, maxillary, and dentary teeth, procurrent caudal-fin rays, and pterygiophores were taken only from cleared and stained paratypes (C&S), prepared according to Taylor and Van Dyke (1985); number of examined specimens are in parentheses. Osteological nomenclature follows Weitzman (1962). Diagnosis was made based on a unique combination of character states, according to Davis and Nixon (1992). Information about congeners was based on both comparative material and literature (e.g Lucena 1987, Mattox and Toledo-Piza 2012, Menezes and Lucena 2014). Institutional abbreviations are: **CICCAA** Coleção Ictiológica do Centro de Ciências Agrárias Ambientais, Universidade Federal do Maranhão, Chapadinha; **CPUFMA** Coleção de Peixes da Universidade Federal do Maranhão, São Luis; **UFRJ** Coleção Ictiológica do Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro; **MCP** Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre; **USNM** Smithsonian Institution National Museum of Natural History, Washington D.C., U.S.A; **CM** Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, U.S.A; and **MHNM** Museo Nacional de Historia Natural y Antropología, Zoologia, Seccion Ictiología, Ministerio de Educación y Cultura, Montevideo, Uruguay.

Results

***Charax awa* sp. n.**

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Fig. 1

Charax gibbosus [*non Charax gibbosus* (Linnaeus, 1758)]: Martins and Oliveira 2011: 196-197.

Charax sp. - Martins and Oliveira 2011:196–197.

Holotype. CICCAA 00752, 101.3 mm SL, Brazil: Maranhão State: Alto Alegre do Pindaré municipality: Igarapé Mineirão, Rio Mearim basin, 3°42’26”S, 45°56’5”W; Guimarães E. C. and Costa C.H.; 03 Dec. 2015.

Paratypes. All from Maranhão State, Brazil: CICCAA 00248, 9, 47.7–90.6 mm SL; CICCAA 00249, 6 (C&S), 42.6–73.8 mm SL; CICCAA 00754, 2, 55.2–68.7 mm SL; collected with holotype. CICCAA 00753, 1 (C&S), 41.4 mm SL, Rio Zutiua (Rio Mearim basin), Santa Inês municipality, 3°43’48”S, 45°35’7”W; Guimarães E. C. and Costa C.H.; 03 Dec 2015.CICCAA 00766, 1 (C&S), 78.5 mm SL, Rio Zutiua (Rio Mearim basin), Santa Inês municipality, 3°43’48”S, 45°35’7”W; Guimarães E. C. and Costa C.H.; 03 Dec 2015. CICCAA 00755, 1, 59.8 mm SL; stream at the Santa Inês municipality (Rio Mearim basin), Santa Inês municipality, 3°40’48”S, 45°19’51”W; Guimarães E. C. and Costa C.H.; 03 Dec 2015.CICCAA 00896, 2, 40.2–48.8 mm SL stream Arapapá (Rio Mearim basin), Alto Alegre municipality; 3°42’30”S, 46°0’19”W; Guimarães E. C. and Brito P. S; 15 Ago 2017.CICCAA 00765, 11, 44.4–68.3 mm SL Lirio stream (Rio Mearim basin), Alto Alegre municipality; 3°38’56”S, 45°46’18”W; Guimarães E. C. and Brito P.S; 15 Ago 2017.CICCAA 00764, 5, 68.4–89.3 mm SL, Olho d’água dos Carneiros (Rio Mearim basin), Santa Inês municipality; 3°43’0”S, 45°28’36”W; Guimarães E. C. and Brito P.S; 11 Ago 2017. CICCAA 00898, 1, 62.2 mm SL, stream at Miranda do Norte municipality (Rio Mearim basin), 3°31’30”S, 44°35’6”W; Guimarães E. C. and Brito P.S.; 13 Ago 2017.

UFRJ 11696, 2, 69.9–70.6 mm SL stream Arapapá (Rio Mearim basin), Alto Alegre municipality; 3°42’30”S, 46°0’19”W; Guimarães E. C. and Brito P.S; 15 Ago 2017. MCP 52700, 4, 45.9–75.1 mm SL Arapapá stream (Rio Mearim basin), Alto Alegre municipality; 3°42’30”S, 46°0’19”W; Guimarães E. C. and Brito P.S; 15 Ago 2017. CPUFMA 98859, 40, 52.2–120.0 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality;

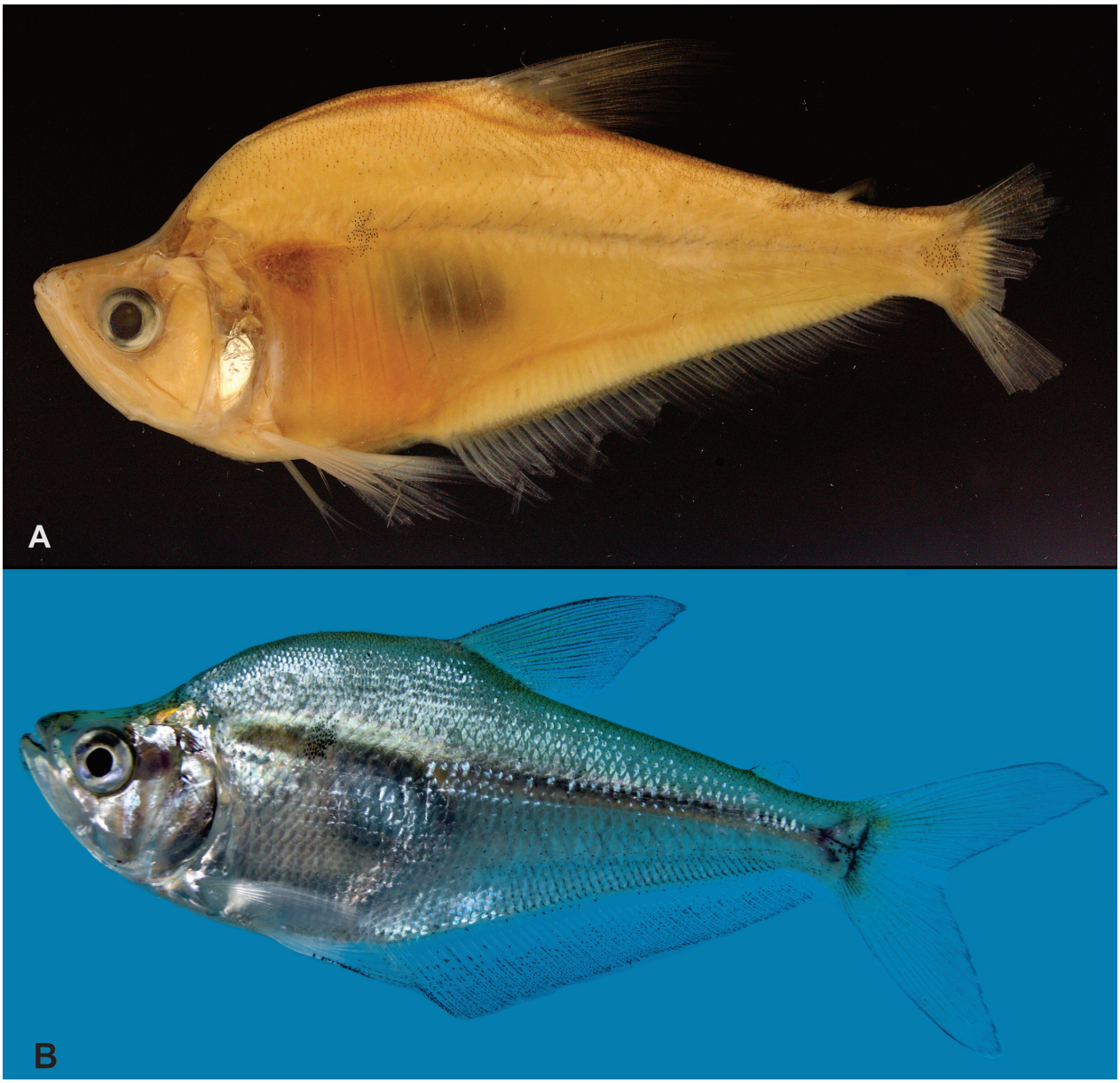

Figure 1. *Charax awa*: (**A**) Holotype, CICCAA 00752, 101.33 mm SL; Brazil, Maranhão, Alto Alegre do Pindaré, Pindaré river drainage, Mearim river basin. (Photographed by Beldo Ferreira). (**B**) Live specimen, paratype, CICCA00898, 62.2 mm SL; Brazil, Maranhão, Miranda do Norte, stream at the Miranda do Norte, Mearim river basin. (Photographed by Erick Guimarães).

2°27’35”S, 45°30’42”W; Piorski et al. 8 Ago 1998. CPUFMA 001747, 18, 76.9–117.3 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27’35”S, 45°30’42”W; Piorski et al. 17 Abr 2000. CPUFMA 112036, 4, 88.5–88.7 mm SL, Rio Munim, Chapadinha municipality; 3°50’19”S, 43°19’46”W; Nunes et al. 8 Jul 2011. CPUFMA 98136, 3, 85.2–93.7 mm SL, Lago de Viana (Rio Mearim basin), Cajari municipality; 3°22’48”S, 45°2’57”W; Piorski and Pereira, 17 Mar 1998. CPUFMA 98135, 3, 85.6–91.4 mm SL, Lago de Viana (Rio Mearim basin), Cajari municipality; 3°18’54”S, 45°1’40”W; Piorski and Pereira, 17 Mar 1998. CPUFMA 98137, 1, 88.2 mm SL, Lago de Viana (Rio Mearim basin), Viana municipality; 3°15’9”S, 45°4’48”W; Piorski and Pereira, 14 Mar 1998. CPUFMA 97130, 1, 91.3 mm SL, stream Engenho (Rio Mearim basin), Viana municipality; 3°12’26”S, 44°58’5”W; Piorski and Pereira, 6 Dez 1997.

Non type material. All from Maranhão State, Brazil: CPUFMA 98861, 24, 83.5–120.0 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27’35”S, 45°30’42”W; Piorski et al. 8 Ago 1998. CPUFMA 98862, 23, 79.4–119.1 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27’35”S, 45°30’42”W; Piorski et al. 14 Ago 1998. CPUFMA 00863, 25, 68.0–113.1 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27’35”S, 45°30’42”W; Piorski et al. 21 Ago 2000. CPUFMA 00864, 43, 72.3–113.9 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27’35”S, 45°30’42”W; Piorski

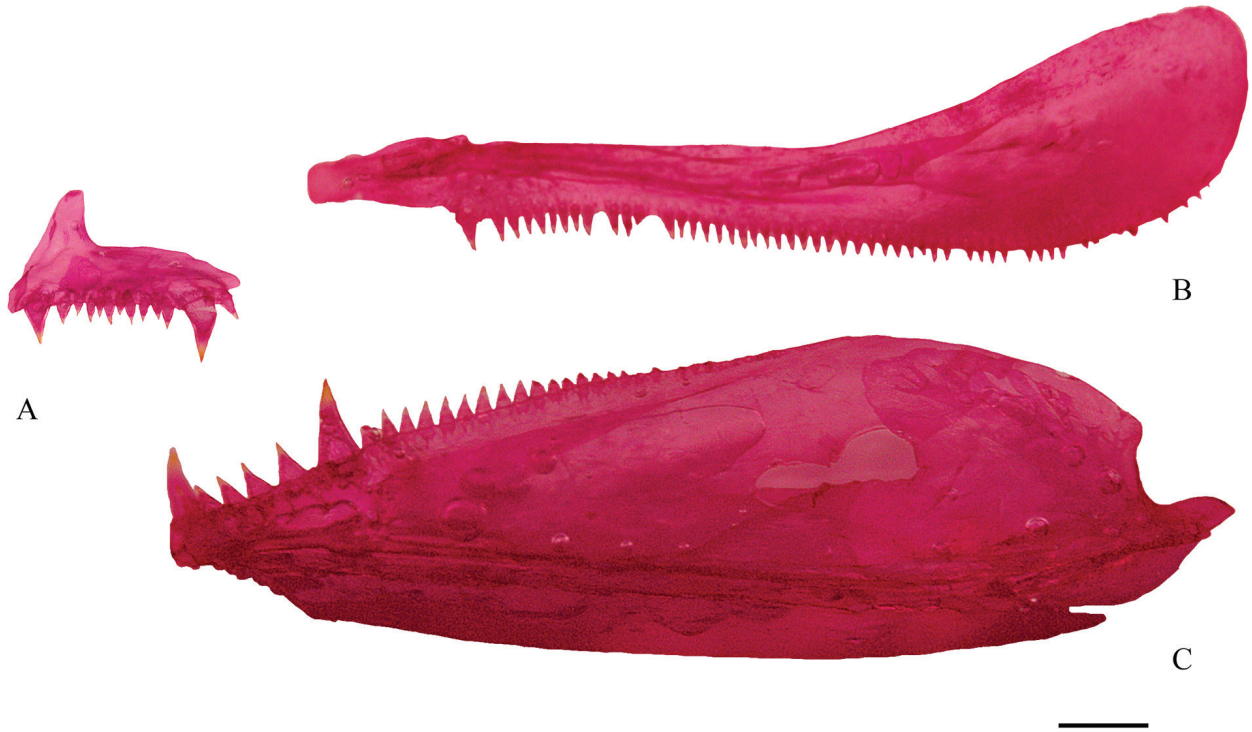

Figure 2. *Charax awa*, CICCAA00249, 73.8 mm SL; Jaws*:* (**A**) premaxilla, (**B**) maxilla and (**C**) lower jaw. Scale bar 1 mm. (Photographed by Erick Guimarães and Beldo Ferreira).

et al. 16 Out 2000. CPUFMA 00865, 11, 82.3–114.2 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27'35"S, 45°30'42"W; Piorski et al. 21 Ago 2000. CPUFMA 00866, 31, 82.6–110.3 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27'35"S, 45°30'42"W; Piorski et al. 15 Out 2000. CPUFMA 00867, 16, 88.7–102.12 mm SL, Rio Turiaçu, (Rio Turiaçu basin), Santa Helena municipality; 2°27'35"S, 45°30'42"W; Piorski et al. 22 Jun 2000.

Diagnosis. *Charax awa* sp. n. can be distinguished from *C. apurensis* Lucena, 1987, *C. condei* (Géry & Knöppel, 1976), *C. delimai* Menezes & Lucena, 2014, *C. gibbosus* (Linnaeus, 1758), *C. hemigrammus* (Eigenmann, 1912), *C. leticiae* Lucena, 1987, *C. macrolepis* (Kner, 1858), *C. metae* Eigenmann, 1922, *C. michaeli* Lucena, 1989, C. *niger* Lucena, 1989, *C. pauciradiatus* (Günther, 1864), *C. stenopterus* (Cope, 1894) *C. tectifer* (Cope, 1870) by the orbital diameter (22.1–28.5% HL vs. 29.6–38.4% HL combined) (Fig. 2). *Charax awa* sp. n. differs from *C. caudimaculatus* Lucena, 1987 by the possession of a longer snout (snout length 23.3–32.8% HL vs. 20.3–22.8% HL); from *C. notulatus* Lucena, 1987 by the number of scales around the caudal peduncle (15–18 vs. 20–22) and by having more vertebrae (35 vs. 32). Furthermore, *Charax awa* sp. n. can be distinguished from *C. condei*, *C. hemigrammus* and *C. stenopterus* by having the lateral line complete (vs. incomplete); from *C. delimai*, *C. metae* and *C. tectifer* by having a toothless ectopterygoid (vs. presence of teeth on ectopterygoid) and having the anal-fin origin always anterior to the vertical through the dorsal-fin origin (vs. anal-fin origin on, or slightly posterior to the vertical through the dorsal-fin origin); from *C. condei*, *C. delimai*, *C. hemigrammus*, *C. metae*, *C. pauciradiatus* and *C. stenopterus* by the number of scale rows from the pelvic-fin origin to the lateral line (11–12 vs. 6–10 combined); from *C. pauciradiatus* by having more scale rows from the dorsal-fin origin to the lateral line (15–18 vs. 13–14). It can be distinguished from *C. niger* by having 8–10 transverse scale rows in space from the humeral spot to the supracleithrum (vs. 5–6); from *C. condei*, *C. delimai*, *C. metae*, *C. rupununi* Eigenmann, 1912 by the number of scale rows around the caudal peduncle (15–18 in *C. awa* sp. n. vs. 12–14 combined in *C. condei* and *C. rupununi*, 19–21 combined in *C. delimai* and *C. metae*). Finally, it differs from *C. leticiae* by having the maxilla extending to a vertical line posterior to pupil, near the posterior orbital margin (vs. maxilla extending slightly beyond vertical through middle of pupil) and from humeral spot distance (35.8–38.0 % SL vs. 39.0–44.0 % SL).

Description. Morphometric data are presented in Tables 1 and 2. Body moderately large (40.2–120.0 mm SL), compressed and moderately deep; greatest body depth slightly in advance of dorsal-fin origin. Dorsal profile of head and body slightly convex on tip of snout, approximately straight from posterior border of posterior nostril to vertical line through posterior border of pupil, concave from that point to about half of distance between pupils and posterior margins of preopercle, strongly convex from that point to dorsal-fin origin, nearly straight along dorsal-fin base and from end of dorsal-fin base to caudal peduncle and slightly concave along caudal peduncle. Ventral pro-

Table 1. Morphometric data of *Charax awa*.

Measurements	Holotype	N	Paratypes	Mean	SD
Standard length (SL)	101.3	107	40.2–120.0	88.4	–
Percentages of standard length					
Depth at dorsal-fin origin	40.0	106	27.7–42.5	37.8	2.8
Snout to dorsal-fin origin	55.0	106	46.5–57.9	52.4	1.5
Snout to pectoral-fin origin	28.4	104	22.8–37.0	28.5	1.8
Snout to pelvic-fin origin	35.5	105	28.6–48.3	37.1	1.8
Snout to anal-fin origin	51.9	103	42.4–65.4	50.3	3.6
Caudal peduncle depth	10.3	102	7.9–14.7	10.1	1.1
Caudal peduncle length	8.0	88	4.9–10.7	7.5	1.3
Pectoral-fin length	21.9	73	14.6–25.9	19.8	2.0
Pelvic-fin length	20.8	67	13.4– 24.7	20.2	2.3
Dorsal-fin base length	12.7	101	8.7–15.2	11.0	1.1
Dorsal-fin height	29.9	64	21.8–49.6	28.7	3.6
Anal-fin base length	53.2	95	42.7–66.2	49.5	3.7
Eye to dorsal-fin origin	44.1	103	36.8–52.9	41.5	2.9
Dorsal-fin origin to caudal-fin base	54.8	101	46.3–69.5	53.9	3.0
Humeral spot distance	37.7	42	32.1–38.0	37.9	3.0
Bony head length	26.7	101	23.9–29.5	26.1	1.0
Percentages of head length					
Horizontal eye diameter	25.4	100	22.1–28.5	25.4	1.6
Snout length	27.2	100	23.2–35.1	26.9	2.4
Least interorbital width	26.2	101	18.9–31.1	25.0	2.2
Upper jaw length	70.6	100	52.1–75.5	62.8	3.9

Table 2. Morphometric data related to the horizontal eye diameter of *Charax awa* presented in separate classes of standard length.

Measurements	N	Paratypes	N	Paratypes
Standard length (SL)	33	40.2–79.2	74	81.6–120.0
Percentages of head length				
Horizontal eye diameter	29	26.1–28.5	71	22.1–25.4

file of head and trunk convex from tip of lower jaw to anal-fin origin, nearly straight along anal-fin base and slightly concave from end of anal-fin base to beginning of procurrent rays. Snout pointed. Lower jaw included in upper jaw when mouth closed. Maxilla extending to a vertical line posterior to pupil, near the posterior orbital margin. Small triangular posteriorly directed projection at intersection between dorsal and posterior margins of hyomandibular (Mattox and Toledo-Piza 2012: figs 24A, 25B).

Dorsal-fin rays ii, 9 (72). Dorsal-fin pterygiophores 10 (8); first dorsal-fin pterygiophore between 4th and 5th vertebrae. Adipose fin present. Unbranched anal-fin rays iv (74) or v (1), branched rays 46 (4), 47 (5), 48 (10), 49 (13), 50 (9), 51 (6), 52 (13), 53 (5), 54 (2) or 56 (1). Anal-fin pterygiophores 46 (2), 47 (2), 48 (1), 49 (2) or 50 (1); first anal-fin pterygiophore between 7th and 8th vertebrae. Pectoral-fin rays i, 13 (3) or 14 (22). Tips of longest pectoral-fin rays reaching slightly beyond middle of pelvic-fin length. Pelvic-fin rays i, 7 (64) or i, 8 (2). Axilar scale on pelvic fin absent. Tips of longest pelvic-fin rays reaching anal-fin rays, between bases of second to seventh branches. Principal caudal-fin ray count 10/9 (59). Dorsal procurrent caudal-fin rays 12 (1), 14 (2), 15(1), 16 (2) or 17 (2). Ventral procurrent caudal-fin rays 7 (3), 8 (2), 9 (1), 1 (10) or 11 (1).

Ventral-most longitudinal series of scales on each side of trunk overlapping one another, delimiting longitudinal gap on region anterior to anus. Scale sheath along anal-fin base. Scales on caudal fin restricted to base of rays. Lateral line complete; perforated scales 53 (1), 54 (3), 55 (8), 56 (10), 57 (4), 58 (2), 59 (4), 60 (7), 61 (4), 62(3) or 63 (1). Horizontal scale rows between dorsal-fin origin and lateral line 15 (27), 16 (20), 17 (5) or 18 (3). Horizontal scale rows between pelvic-fin origin and lateral line 11 (66) or 12 (4). Horizontal scale rows between anal-fin origin and lateral line 12 (2), 13 (37), 14 (16), 15 (7) or 16 (1). Scale rows around caudal peduncle 15 (4), 16 (26), 17 (13) or 18 (3). Scale row along anal-fin base, extending for about two thirds of fin base. Predorsal scales 49 (1), 50 (6), 52 (9), 53 (5), 54(7), 55(3), 56(3), 57 (1), 58 (1), 59 (1), 60 (1), 62 (4), 63 (2), 64 (1), 66 (1), 68 (2). Transverse scale rows between humeral spot and supracleithrum 8 (57), 9 (16) or 10 (1).

Premaxilla and dentary with two canine-like teeth and remaining teeth conical. Maxilla with all teeth conical. Premaxilla with one anterior canine-like tooth followed by set of smaller conical teeth, another canine-like tooth placed on posterior portion of bone, followed by one or two small conical teeth (Fig. 2). Total number of premaxillary teeth 13 (4), 14 (3) or 15 (1). Maxilla with 52 (1), 55 (4), 58 (2) or 60 (1) teeth. Dentary with one canine-like tooth followed by 3–4 conical teeth, another canine-like tooth followed by a posterior row of 16 (3), 18 (4) or 19 (1) conical teeth (Fig. 2).

Ectopterygoid and metapterygoid without teeth. Gill-rakers on lower limb of first gill-arch 13 (2), 14 (3). Branchiostegal rays 3 (1) or 4 (7). Supraneurals 4 (8); first supraneural inserted posterior to neural spine of 4th centrum, and last supraneural inserted anterior to first dorsal-fin pterygiophore. Precaudal vertebrae 12 (8). Caudal vertebrae 23 (8). Total vertebrae 35 (8). Pleural rib pairs 11 (8). Pre- and postzygapophyses minute, approximately triangular in shape, and positioned somewhat parallel to neural zygapophysis of adjacent vertebra (e.g. Mattox and Toledo-Piza 2012: fig. 32A).

Color in alcohol (Fig. 1A). Body pale yellow to light yellow, slightly darker dorsally. Both extreme dorsal and ventral regions of trunk with scattered dark chromatophores. Inconspicuous approximately rounded or slightly elliptical dark brown humeral blotch, extending about three to four scales horizontally and about five vertically. Dorsal part of head, snout, circumorbital region and opercle darker than rest of head. Scattered dark chromatophores on tip of snout and suborbital region. V-shaped lines of chromatophores over myosepta along epaxial and hypaxial muscles, more visible on mid-posterior portion of body. Inconspicuous, approximately triangular shaped dark blotch on caudal-fin base, with posterior dark chromatophores. Inconspicuous clear stripe at anal-fin base. All fins hyaline, or light brown at base, with scattered dark chromatophores more visible on interradial membranes.

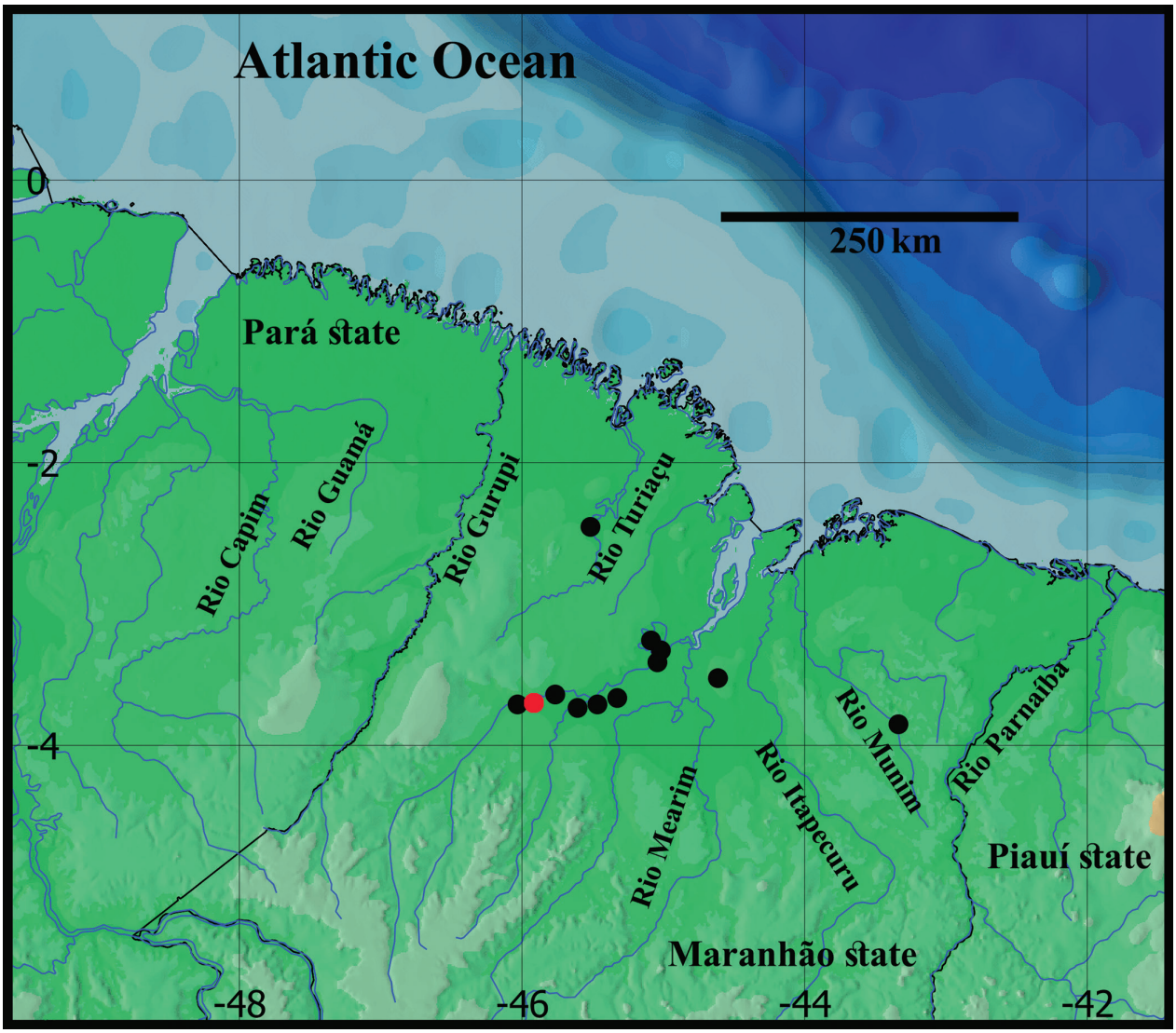

Figure 3. Distribution of *Charax awa* sp. n. Paratypes (black circles) and holotype (red circle).

Anterior portion of first to third unbranched rays of dorsal and first unbranched rays of pectoral and pelvic-fin rays darker than remaining rays.

Color in life (Fig. 1B). Color pattern in life similar to coloration of preserved specimens. Body silver on, anterior portion, and silver to hyaline on posterior portion. Anterior and dorsal portions of trunk darker, and sides of head darker than rest of body. Humeral and caudal-fin base blotches inconspicuous. Dorsal margin of trunk with conspicuous dark brown chromatophores. Purple longitudinal stripe along mid-portion of flank, extending posteriorly to anterior margin of caudal-fin base. Fins hyaline, with scattered dark brown or black chromatophores, more visible on interradial membranes.

Sexual dimorphism. No apparent sexual dimorphism.

Distribution. *Charax awa* is known from the Rio Mearim, Rio Munim and Rio Turiaçu basins, Maranhão state, northeastern Brazil (Fig. 3).

Remarks. The new species herein described differs from its geographically closely distributed congeners, *C. leticiae*, *C. niger*, and *C. pauciradiatus*, with records in the Lower Amazon, Capim, upper Itapecuru and Tocantins river basins (Fig. 4), mainly by the horizontal orbital diameter (see diagnosis section). In addition, *C. awa* sp. n. can be distinguished from *C. leticiae* by having the maxilla extending to a vertical line posterior to pupil, near posterior orbital margin while *C. leticiae* shows the maxilla extending slightly beyond vertical through middle of pupil and by humeral spot distance (32.1–38.0 % SL vs. 39.0–44.0 % SL). It can be distinguished from *C. pauciradiatus* by possessing 11–12 scale rows from the pelvic-fin origin to the lateral line and 15–18 scale rows from the dorsal-fin origin to the lateral line, while *C. pauciradiatus* possess 6–10 and 13–14, respectively, and differs from *C. niger* by having 8–10 transverse scale rows in space from the humeral spot to the supracleithrum, while *C. niger* possess 5–6. Moreover, it differs from *C. pauciradiatus* and *C. niger* by the absence of bony hooks on anal and pelvic-fins rays of adult males. This last character is emphasized in the discussion section.

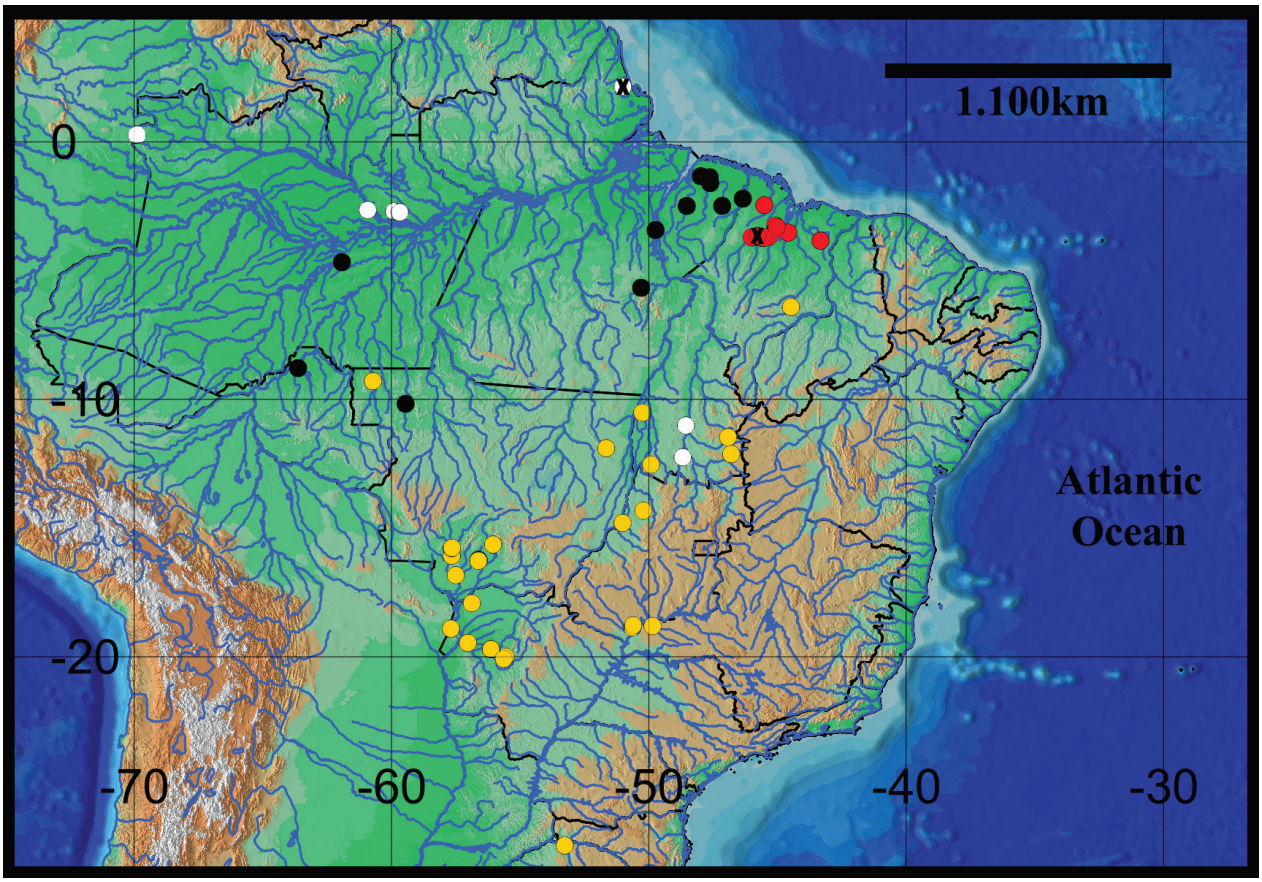

Figure 4. Distribution of *Charax awa* sp. n., *C. leticiae*, *C. pauciradiatus* and *C. niger*. *Charax awa* sp. n. (red circle), *C. leticiae* (yellow circle), *C. pauciradiatus* (black circle) and *C. niger* (white circle). The type localities of the species are marked with an asterisk. Information of this map was based on our examined material and data provided by Lucena 1987, and Menezes and Lucena 2014 . See Suppl. material 1.

In addition, new species herein described differs from *C. gibbosus*, a species incorrectly identified for the same area of *C. awa* sp. n. by the following features:

Charax awa sp. n. possesses a toothless ectopterygoid, absence of bony hooks on anal-fin rays of mature males, 8–10 transverse scales rows between the humeral spot and the suprecleithrum and 49–68 predorsal scales; while *C. gibbosus* has teeth on ectopterygoid, bony hooks on anal-fin rays of mature males, 5–6 transverse scales rows between the humeral spot and the suprecleithrum, and 38–45 predorsal scales.

Etymology. The specific epithet honors the term *Awá*, from Tupi-guarani, meaning "man, people, person", used by the native tribe Guajá, from the Maranhão state, for their self-denomination.

Discussion

Several authors have pointed out that *Charax* constitutes a monophyletic genus within the Characinae (Lucena 1987; Mirande 2010; Mattox and Toledo-Piza 2012; Menezes and Lucena 2014). The sister-group relationship between *Charax* and *Roeboides* was suggested by several authors (Lucena 1998, 2000; Mirande 2009, 2010; Mattox and Toledo-Piza 2012). However, Oliveira et al. (2011) alternatively suggested a different relationship between these two genera, proposing that *Charax* is the sister group of the clade comprising *Roeboides* Günther, 1864 and *Cynopotamus* Valenciennes, 1850. The presence of (1) a well-developed notch on the latero-ventral portion of cleithrum originating a relatively long posterior spiniform projection extending below pectoral-fin base and (2) an anterior shorter process oriented straight forward, or either inclined or bent laterally, was proposed by Lucena (1987) as the synapomorphies of the genus, a hypothesis corroborated by Mattox and Toledo-Piza (2012) and confirmed in the new species herein described (Fig. 5).

Charax awa sp. n. possesses a relatively small eye or orbital diameter when compared to the other congeners, except *C. notulatus* and *C. caudimaculatus* (22.1–28.5 % HL; 26.1–28.5 % HL on specimens below 80 mm SL; and 22.1–25.4 % HL on specimens above 80 mm SL; see Tables 1 and 2). Despite the larger specimens of *C. awa* sp. n. usually have a tendency to have smaller eye diameters when compared to the smaller specimens, the combined range of the eye diameter of these two size categories is even useful for the discrimination of the new species of all the congeners which possess a relatively larger eye diameter (29.6–

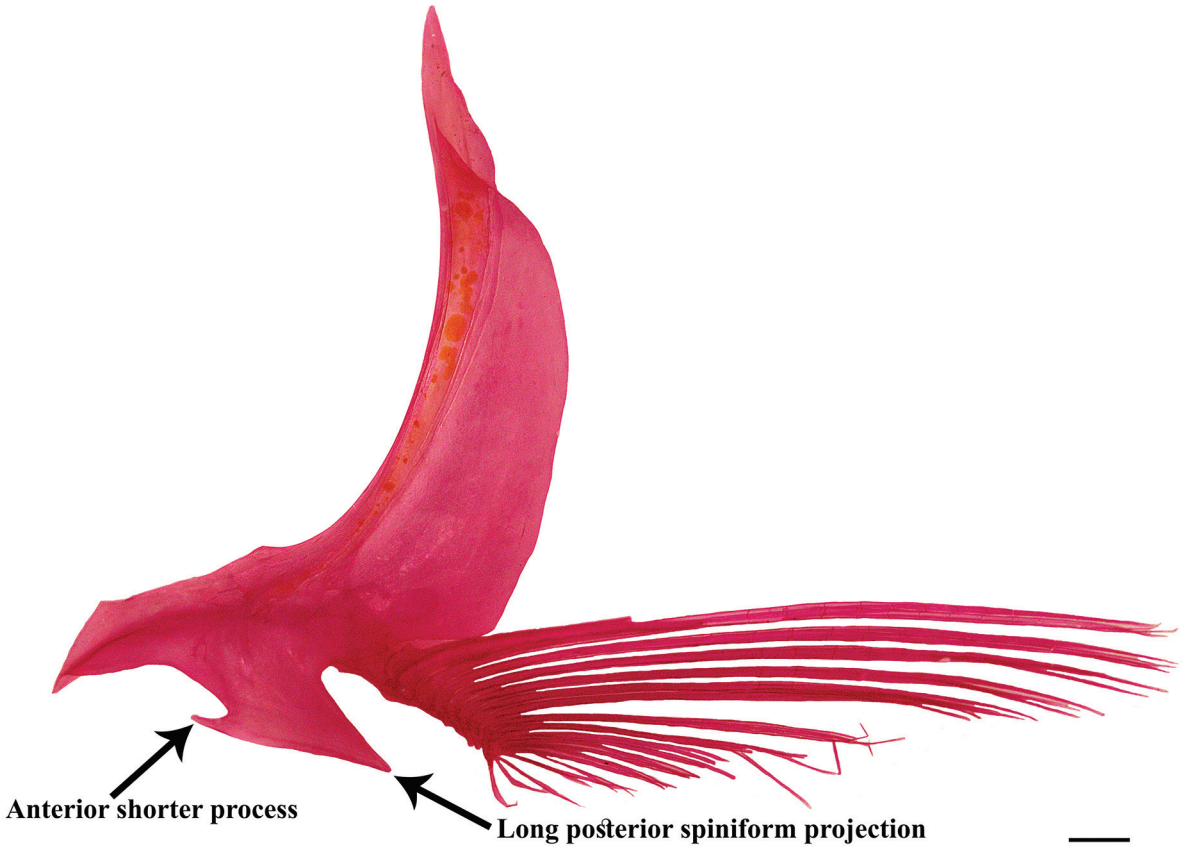

Figure 5. *Charax awa*, CICCAA00248, 73.8 mm SL; Pectoral girdle. Scale bar 1 mm. (Photographed by Erick Guimarães and Beldo Ferreira).

38.4 % HL combined). It is important to emphasize that the eye or orbital diameter is the main diagnostic character of *Charax* according to Menezes and Lucena (2014), which had used this character on their identification key to species of *Charax*, and as the first diagnostic feature in most of the species diagnoses. Other characters widely used by the last taxonomic revision of the genus were the lateral line, different types of scale counts, and the absence or presence or the number of teeth on the ectopterygoid. We confirmed here these characters as useful for species discrimination and taxonomy of the genus.

According to Menezes and Lucena (2014) a sexual dimorphism characterized by the presence of bony hooks on the anal and pelvic-fin rays of adult males is only recorded for *C. pauciradiatus*, *C. michaeli*, *C. gibbosus* and *C. niger* (in the case of the latter two, only in the anal-fin rays). Therefore, they concluded that the absence of these bony hooks is predominant across *Charax*. *Charax awa* sp. n. apparently exhibits this general pattern of the genus, since bony hooks on these fins were not recorded in any of our examined material of the species, including 220 specimens over 84.0 mm SL. Thus, the species apparently does not possess an evident sexual dimorphism.

The river systems of northeastern Brazil, particularly the river basins of its occidental portion, including the region between the Rio Gurupi and Parnaíba basin, remain with their ichthyofauna poorly known and scarcely studied, despite recent efforts to sample and inventory this area (e.g. Soares 2005, Barros et al. 2011, Ribeiro et al. 2014, Ramos et al. 2014, Matavelli et al. 2015, Melo et al. 2017, Piorski et al. 2017). The present study is an example of this state of knowledge. Further refined taxonomic studies will probably unveil more species and new taxa occurring in this area. Despite some freshwater fish species have been described occurring in this region and adjacent areas [e.g. *Corydoras julii* Steindachner, 1906, *Corydoras treitlii* Steindachner, 1906, *Knodus victoriae* (Steindachner, 1907), *Otocinclus hasemani* Steindachner,1915, *Hemiodus parnaguae* Eigenmann & Henn, 1916, *Corydoras vittatus* Nijssen, 1971, *Pterygoplichthys parnaibae* (Weber, 1991), *Auchenipterus menezesi* Ferraris & Vari, 1999, *Roeboides margareteae* Lucena, 2003, *Geophagus parnaibae* Staeck & Schindler, 2006, *Roeboides sazimai* Lucena, 2007, *Platydoras brachylecis* Piorski, Garavello, Arce H. & Sabaj Pérez, 2008, *Cichlasoma zarskei* Ottoni, 2011, *Poecilia sarrafae* Bragança & Costa, 2011, *Hypsolebias coamazonicus* Costa, Amorim & Bragança, 2014, *Anablepsoides vieirai* Nielsen, 2016, *Parotocinclus cabessadecuia* Ramos, Lima & Ramos, 2017 and *Hypostomus sertanejo* Zawadzki, Ramos & Sabaj Pérez, 2017]. Studies on range extension and new records of some freshwater fishes from the area between the mouth of Rio Gurupi and Delta do

Rio Parnaíba (e.g. Barros et al. 2011, Matavelli et al. 2015, Guimarães et al. 2017a, 2017b, Lima et al. 2017), as well as the description of new species (cited above), suggest that the biogeographic history of the river basins of the region is complex and still poorly known. This region is an extremely ecologically relevant area since it comprises three of the main Brazilian biomes, as well as, transition zones between them: Amazônia, Brazilian Cerrado and Caatinga. Therefore, this area has faunal and floristic representatives of these three biomes, which makes it extremely relevant in terms of ecology, biodiversity and conservation (Olson, et al. 2001; Piorski et al. 2008, Fiaschi and Pirani 2009; Miranda et al. 2012).

Comparative material. *Charax caudimaculatus:* USNM 263877, 1, 95 mm SL, Laguna Cococha, Reserva National de Tambopata, Madre de Dios, **Peru.** (Radiograph of a Paratype). USNM 280291, 1, 95.0 mm SL, Laguna Cococha, Reserva National de Tambopata, Madre de Dios, **Peru.** (photograph of holotype).

Charax leticiae: all from **Brazil**: UFRJ: 1576, 4, 66.6–71.1, Goias State, Aruanã municipality. CICCAA 00762, 2, 79.1–80.0 mm SL, Pará State, Parauapebas municipality. CPUFMA121858, 1, 81.0 mm SL, Maranhão state, stream at the Parque Estadual do Mirador (Rio Itapecuru basin), Mirador municipality.

Charax pauciradiatus: all from Maranhão State, **Brazil**. CICCAA00899, 3, 79.1–84.7. Maranhão State, Igarapé Papagaio, Tocantins river basin, São Pedro da Agua Branca Municipality. CPFUMA10860, 6, 88.6–117.46, Igarapé mão-de-onça, Gurupi river basin, Centro Novo Municipality. CPUFMA00868, 9, 103.7–117.94, Gurupi river basin, Centro Novo Municipality. CPUFMA10869, 7, 98.5–113.0, Gurupi river basin, Centro Novo Municipality. CPUFMA11870, 8, 93.9–112.6, Gurupi river basin, Centro Novo Municipality. CPUFMA11871, 3, 89.1–113.2, Gurupi river basin, Centro Novo Municipality.

Charax notulatus: USNM: 360305, 1 (photograph of holotype), 77 mm SL, Guarico State, Cano Falcon, **Venezuela.**

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Supplementary material 1

Distribution of *Charax awa* sp.n., C. leticiae, *C. pauciradiatus*, and *C. niger*

Authors: Erick Cristofore Guimarães, Pâmella Silva De Brito, Beldo Rywllon Abreu Ferreira, Felipe Polivanov Ottoni

Data type: Microsoft Excel Worksheet (.xlsx)

Explanation note: Information of this map was based on our examined material and data provided by Menezes and Lucena (2014).

Link: https://doi.org/10.3897/zse.94.22106.suppl1