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## A new species of *Characidium* Reinhardt (Ostariophysi: Characiformes: Crenuchidae) from coastal rivers in the extreme south of Bahia, Brazil

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### Abstract

*Characidium helmeri*, a species of the family Crenuchidae apparently endemic to rivers draining the extreme south of Bahia, Brazil, is described. The new species is easily distinguished from congeners by having dark, vertically elongated, irregular spots or dashes on flanks, usually more evident over midlateral stripe and/or ventral half of body, where it may present a somewhat curved or zigzag-shape. *Characidium helmeri* can be further distinguished from most congeners by having lateral line reduced to 13–22 pored scales, adipose fin absent, isthmus naked on its anteriormost portion, 14 scales around caudal peduncle, 4 scales above lateral line and 4 below, two series of dentary teeth, supraorbital absent or extremely reduced, and basicaudal black spot well defined. The occurrence of reductive characters in *Characidium* is briefly discussed.

**Key words:** Characidiinae, Taxonomy, Reductive characters

### Resumo

*Characidium helmeri*, uma espécie da família Crenuchidae aparentemente endêmica de rios que drenam o extremo sul da Bahia, Brasil, é descrita. A nova espécie é facilmente diferenciada das congêneres por ter manchas ou traços irregulares escuros alongados verticalmente nas laterais do corpo, usualmente mais evidentes sobre a faixa mediana lateral e/ou metade ventral do corpo, onde podem apresentar forma curva ou de zigue-zague. *Characidium helmeri* pode ser ainda diferenciada da maioria das congêneres por ter linha lateral reduzida a 13–22 escamas perfuradas, nadadeira adiposa ausente, istmo nu na porção anterior, 14 escamas ao redor do pedúnculo caudal, 4 escamas acima da linha lateral e 4 abaixo, duas séries de dentes no dentário, supraorbital ausente ou extremamente reduzido e mancha na base da nadadeira caudal bem definida. A ocorrência de caracteres redutivos em *Characidium* é brevemente discutida.

**Palavras chave:** Characidiinae, Taxonomia, Caracteres redutivos

### Introduction

*Characidium* is the most species-rich genus of Crenuchidae, with 59 valid species of small freshwater fishes widely distributed in the Neotropical Region (Eschmeyer, 2015). Seventeen species of *Characidium* are known to occur in coastal drainages of eastern Brazil and most of them are described from rivers occurring between Rio de Janeiro and Rio Grande do Sul states. Three species are known from northeastern Brazil: *C. bahiense* Almeida, *C. bimaculatum* Fowler, and *C. samurai* (Zanata & Camelier, 2014). A new congener apparently endemic to coastal streams in the extreme southern Bahia, with a remarkable combination of reductive characters, is presented herein. Reductive characters are known to occur in at least 13 species of *Characidium* in the Amazon, Paraná-Paraguay,

São Francisco, and coastal Brazilian drainages. The phylogenetic relationships among some of those species were analyzed by Buckup (1993a) and Netto-Ferreira *et al.* (2013), with the proposed hypotheses including some clades supported solely by reductive characters. The phylogenetically informative nature of these characters in characidiins is well accepted, although their independence and origin by convergence among congeners was previously questioned, as in Buckup (1993a). The occurrence of reductive characters in *Characidium* is briefly discussed.

## Material and methods

Measurements and counts were performed according to the methods of Buckup (1993b). Measurements were taken with a digital caliper to the nearest 0.1 mm and expressed as percent of standard length (SL), except subunits of head, given as percentages of head length (HL). Frequencies are presented in parentheses after the respective characteristic, and an asterisk indicates holotype data. Observations on vertebrae, ectopterygoid teeth, branchiostegal rays, procurrent caudal-fin rays, caudal-fin rays, epurals, and other osteological observations were made only in cleared and stained (CS) paratypes, prepared according to the method of Taylor & Van Dyke (1985).

The number of CS specimens or specimens preserved in ethanol for DNA extraction (mol) is given after the total number of specimens. Pattern of *circulii* and *radii* was observed on scales situated between dorsal-fin base and lateral line. Gender of some specimens was confirmed by dissection and stages of gonadal maturity were defined according to Vazzoler (1996). Pseudotympanum morphology was assessed by removal of the overlying skin, adipose tissue, and lateral-line nerve of alcohol-preserved specimens. Specimens examined belong to the following institutions: MBML (Museu de Biologia Professor Mello Leitão, Santa Teresa), MZUSP (Museu de Zoologia da Universidade de São Paulo, São Paulo), MNRJ (Museu Nacional da Universidade Federal do Rio de Janeiro, Rio de Janeiro), and UFBA (Museu de Zoologia da Universidade Federal da Bahia, Salvador).

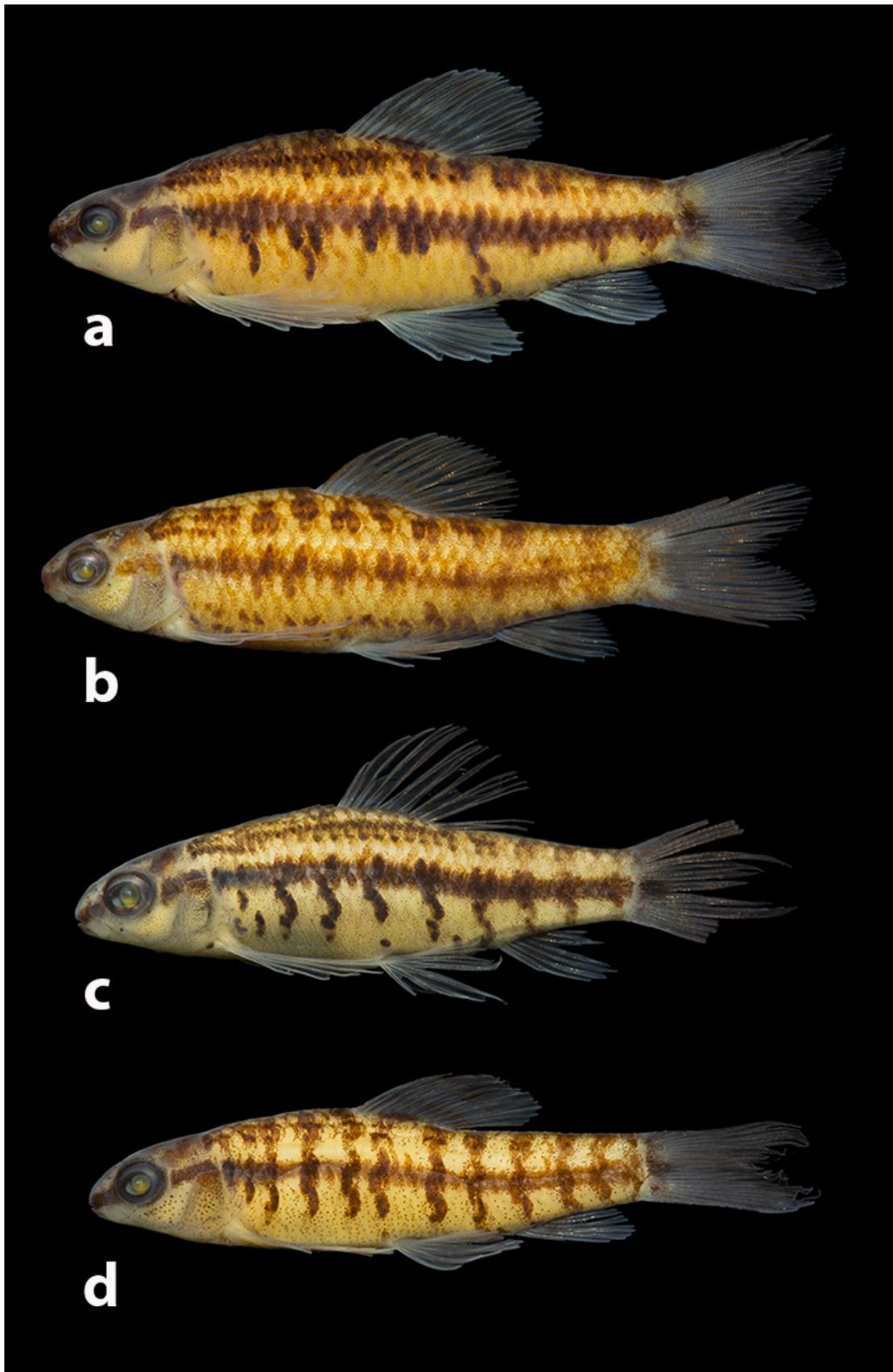
## *Characidium helmeri*, new species

(Fig. 1–4)

*Characidium* sp. 2—Sarmiento-Soares *et al.*, 2009: 146 (species list).

**Holotype.** MNRJ 42610, 40.4 mm SL, Brazil, Bahia, Prado, rio Ribeirão, on road between Cumuruxatiba and Corumbau, tributary of rio Cahy, 17°00'45"S 39°12'07"W, 17 m above sea level, L.M. Sarmiento-Soares, R.F. Martins-Pinheiro, A.T. Aranda & C.C. Chamon, 24 Oct 2004.

**Paratypes.** All from Brazil, Bahia. Prado: MNRJ 29038, 14, 21.5–35.5 mm SL, MBML 3834, 5, 19.5–26.8 mm SL, MBML 7365, 1 CS, 26.9 mm SL, collected with holotype. MZUSP 27003, 1, 32.2 mm SL, Cumuruxatiba, rio do Peixe Grande, 17°05'25" S 39°12'54"W, 17 m above sea level, R.M.C. Castro, 20 Feb 1979. MZUSP 74029, 4, 23.4–28.5 mm SL, rio Imbassuaba at Fazenda Embaçoaba, 17°04'53" S, 39°15'56"W, 33 m above sea level, Expedição MZUSP/USNM, 20 Mar 1985. MZUSP 112666, 24, 1 mol, 16.7–30.3 mm SL, rio Ribeirão, tributary of rio Cahy Braço Norte, on road between Barra do Cahy and Ponta do Corumbau, 17°00'45"S, 39°12'05"W, 27m above sea level, O.T. Oyakawa, A.M. Zanata, P. Camelier & T.F. Teixeira, 9 Aug 2012. MZUSP 112653, 21, 1 mol, rio Cahy Braço Norte, on road between Barra do Cahy and Ponta do Corumbau, 16°59'10"S, 39°12'53"W, 8 m above sea level, O.T. Oyakawa, A.M. Zanata, P. Camelier & T.F. Teixeira, 9 Aug 2012. Canavieiras: MZUSP 93899, 1, 32.4 mm SL, affluent of rio Salsa, tributary of rio Pardo on road between Ouricana and Pimenteira, 15°43'53"S, 39°07'44"W, 19 m above sea level, N.A. Menezes, O.T. Oyakawa, L.M. Sousa & J.C. Nolasco, 03 Apr 2006. MZUSP 112433, 1, 32.2 mm SL, affluent of rio Salsa, tributary of rio Pardo, on road between Ouricana and Pimenteira, 15°43'55"S, 39°07'45"W, 24 m above sea level, O.T. Oyakawa, A.M. Zanata, P. Camelier & T.F. Teixeira, 11 Aug 2012. Porto Seguro: MBML 531, 18, 1 CS, 17.2–36.3 mm SL, and MBML 7363, 1 CS, 28.4 mm SL, rio Trancoso, 16°35'15"S, 39°05'41"W, 9 m above sea level, R.L. Teixeira & G.I. Almeida, 07 Apr 2001. MBML 6633, 1, 29.1 mm SL, tributary of rio da Barra near boundaries of RPPN II Fazenda Sol Poente Trancoso, 16°31'49"S, 39°08'56"W, 30 m above sea level, J.L. Helmer, 14 Nov 2012. MBML 6645, 2, 21.9–35.4 mm SL, tributary of Córrego Manoelzinho, affluent of rio do Norte, rio da Barra microbasin in RPPN II Fazenda Sol Poente in Trancoso village, 16°31'20"S, 39°08'12"W, 31 m above sea level, J.L. Helmer, 17 Nov 2012. MBML 6652, 8, 29.6–33.4 mm SL, rio do Norte, tributary of rio da Barra, near boundary of RPPN V Fazenda Nova Esperança I in



**FIGURE 1.** *Characidium helmeri*, (a) holotype, MNRJ 42610, 40.4 mm SL, rio Ribeirão, tributary of rio Cahy, Bahia, Brazil; (b) paratype, MBML 531, 36.2 mm SL, rio Trancoso, Bahia, Brazil; (c) paratype, MZUSP 112653, 30.6 mm SL, rio Cahy Braço Norte, Bahia, Brazil; (d) paratype, MNRJ 29038, 23.2 mm SL, same data as holotype.

Trancoso, 16°32'39"S, 39°06'50"W, 9 m above sea level, J.L. Helmer, 20 Jul 2012. MBML 6668, 4, 35.4–39.8 mm SL, Córrego Manoelzinho, tributary of rio do Norte, affluent of rio da Barra RPPN II Fazenda Sol Poente in Trancoso village, 16°31'21"S, 39°08'29"W, 56 m above sea level, J.L. Helmer, 16 Nov 2012. MBML 6673, 1, 27.3 mm SL, rio do Norte, tributary of rio da Barra, near boundary of RPPN V Fazenda Nova Esperança I in Trancoso, 16°32'39"S, 39°06'50"W, 9 m above sea level, J.L. Helmer, 16 Nov 2012. MBML 6680, 10, 18.2–28.6 mm SL, Rio do Norte, tributary of rio da Barra in RPPN rio do Brasil in Trancoso, 16°30'40"S, 39°08'33"W, 35 m above sea level, J.L. Helmer, 23 Jul 2012. MBML 6688, 9, 26.5–27.2 mm SL, Rio da Barra near boundary of RPPN II Fazenda Sol Poente in Trancoso village, 16°32'18"S, 39°08'34"W, 20 m above sea level, J.L. Helmer, 19 Jul 2012. MBML 6700, 10, 24.3–32.1 mm SL, and MBML 7368, 1 CS, 26.8 mm SL, Rio do Norte, tributary of rio da Barra in RPPN III Fazenda Sol Nascente, in Trancoso village, 16°31'44"S, 39°07'18"W, 24 m above sea level, J.L. Helmer, 20 Jul 2012. MBML 6708, 5, 24.5–37.3 mm SL, Rio da Barra, near boundary of RPPN II Fazenda Sol Poente and Parque Nacional do Pau Brasil near Trancoso, 16°31'45"S, 39°09'02"W, 32 m above sea level, J.L. Helmer, 20 Jul 2012. MBML 6710, 13, 22.2–31.5 mm SL, Rio da Barra after RPPN V Fazenda Nova Esperança I, in Trancoso village, 16°32'44"S, 39°06'59"W, 9 m above sea level, J.L. Helmer, 20 Jul 2012. MBML 6720, 6, 19.9–30.5 mm SL, córrego Manuelzinho, tributary of rio do Norte, tributary of rio da Barra in the RPPN II F Sol Poente in Trancoso, 16°31'21"S 39°08'29"W, 55 m above sea level, J.L. Helmer, 21 Jul 2012. MBML 6725, 2, 23.8–40.7 mm SL, Córrego Manoelzinho, tributary of rio do Norte, tributary of rio da Barra, RPPN II Fazenda Sol Poente in Trancoso, 16°31'21"S, 39°08'29"W, 55 m above sea level, J.L. Helmer, 24 Jul 2012. MBML 6755, 2, 29.9–36.6 mm SL, Rio da Barra near boundary of RPPN II Fazenda Sol Poente in Trancoso, 16°32'18"S, 39°08'34"W, 20 m above sea level, J.L. Helmer, 14 Nov 2012. MBML 6757, 2, 26.6–31.6 mm SL, Rio do Norte, tributary of rio da Barra in RPPN rio do Brasil in Trancoso, 16°30'40"S, 39°08'33"W, 35 m above sea level, J.L. Helmer, 16 Nov 2012. MBML 3963, 4, 29.7–35.6 mm SL, rio das Águas, tributary of rio Trancoso, 16°33'13"S, 39°10'03"W, 42 m above sea level, J.L. Helmer, 9 Dec 2010; MBML 3969, 1, 21.5 mm SL, same data, 8 Jun 2010.



**FIGURE 2.** Paratype of *Characidium helmeri*, MZUSP 112666, 30.3 mm SL, stream on road between Barra do Cahy and Ponta do Corumbau, Bahia, Brazil; photographed live.

**Diagnosis.** *Characidium helmeri* can be distinguished from congeners by having dark, vertically elongated, irregular, narrow spots or dashes, usually more evident over the midlateral stripe and/or ventral half of body, formed by high concentration of melanophores on the posterior half of scales, occurring in a somewhat curved or zigzag-shape. Also differs from congeners by having extremely reduced or complete absence of supraorbital. The new species further differs by having lateral line reduced (*vs.* complete, except in *C. bahiense* Almeida, *C. interruptum* Pellegrin, *C. laterale* (Boulenger), *C. mirim* Netto-Ferreira, Birindelli & Buckup, *C. nupelia* Graça, Pavanelli & Buckup, *C. rachovii* Regan, *C. stigmatosum* Melo & Buckup, and *C. xavante* Graça, Pavanelli & Buckup); adipose fin absent (*vs.* present, except in *C. mirim*, *C. nupelia*, *C. stigmatosum*, and *C. xavante*); and isthmus naked on its anteriormost portion (*vs.* isthmus completely covered by scales in most congeners, except in *C. alipioi* Travassos, *C. boavistae* Steindachner, *C. crandellii* Steindachner, *C. declivirostre* Steindachner, *C. fasciatum* Reinhardt, *C. gomesi* Travassos, *C. grajahuensis* Travassos, *C. japuhybense* Travassos, *C. lauroi*

Travassos, *C. macrolepidotum* (Peters), *C. oiticicai* Travassos, *C. schubarti* Travassos, *C. timbuiense* Travassos, and *C. vidali* Travassos). *Characidium helmeri* differs from *C. bahiense*, *C. interruptum*, *C. laterale*, *C. mirim*, *C. nupelia*, *C. rachovii* and *C. xavante* by having higher number of pored lateral line scales (13–22 vs. 5–11) and two series of dentary teeth (vs. one). The new species further differs from *C. nupelia* and *C. xavante* by the absence of a dark humeral blotch (vs. present) smaller number of dark vertical bars on the body, 7–12 when present (vs. 12–18). *Characidium helmeri* can be differentiated from *C. vestigipinne*, a species with adipose fin absent or reduced, by having two dentary rows of teeth, the outer with tricuspid teeth (vs. one row of conical teeth); 4 scales above lateral line and 4 below (vs. 5 above; and 5 or 6 below); and absence of roundish black marks on pelvic, dorsal, and anal fins (vs. presence). It can be further distinguished from *C. stigmatosum* by presence of a black basicaudal dot (vs. absence), and by having pelvic, pectoral, anal, and caudal fins not dark pigmented in males (vs. pigmented).

**TABLE 1.** Morphometric data of holotype and paratypes of *Characidium helmeri* (number of specimens measured = 44). The range includes the holotype. SD = standard deviation.

	Holotype	Range	Mean	SD
Total length (mm)	51.6	26.7–51.6	–	–
Standard length (mm)	40.4	20.1–40.4	–	–
Percents of standard length				
Depth at dorsal-fin origin	30.9	23.8–30.9	26.6	1.5
Depth at anal-fin origin	22.3	16.3–22.3	18.9	1.2
Caudal-peduncle depth	13.9	11.0–14.5	12.8	0.8
Caudal-peduncle length	18.8	15.9–21.6	19.0	1.3
Snout to dorsal-fin origin	49.3	46.7–52.2	49.0	1.4
Snout to pectoral-fin origin	23.3	22.6–29.4	26.3	1.6
Snout to pelvic-fin origin	54.0	51.2–56.7	53.9	1.3
Snout to anal-fin origin	77.2	72.7–79.9	76.7	1.5
Anal-apex distance	98.5	94.2–100.7	98.0	1.8
Body width	16.8	12.4–16.8	14.2	1.1
Head length	23.5	22.3–28.9	25.9	1.4
Percents of head length				
Horizontal eye diameter	26.3	26.3–34.4	31.3	1.4
Snout length	20.0	19.0–25.4	21.3	1.6
Snout to maxillary tip	26.3	22.8–29.2	25.9	1.5
Anterior naris to orbit	9.5	6.3–11.6	9.3	1.2
Posterior naris to orbit	4.2	2.8–5.1	3.9	0.7
Cheek depth	9.5	6.2–11.3	8.3	1.2
Least interorbital width	17.9	13.1–17.9	15.3	1.3

**Description.** Morphometric data of holotype and selected paratypes presented in Table 1. Body elongate and moderately compressed. Greatest body depth at vertical through dorsal-fin origin. Dorsal profile convex from upper lip to end of occipital process, slightly convex or straight from this point to origin of dorsal-fin base, convex along dorsal-fin base, almost straight between end of dorsal-fin base to origin of anteriormost dorsal procurrent caudal-fin ray. Ventral profile of head straight, except for slightly convex portion close to dentary symphysis, slightly convex from isthmus to pelvic-fin origin, straight from latter point to anal-fin origin, straight from this point to origin of anteriormost ventral procurrent caudal-fin ray. Snout triangular in lateral view, rounded dorsally. Mouth subterminal, aligned or slightly lower than ventral edge of the orbit. Distal tip of maxilla barely reaching vertical through anterior margin of orbit. Orbit approximately round, larger than snout length. Cheek thin, its depth

approximately one third to one sixth of orbit diameter. Nares separated; anterior naris with raised margins, mainly on its posterior border; posterior naris considerably closer to orbit than to anterior naris and with skin flap on its anterior border. Supraorbital absent or extremely reduced and present solely in one side of head (Fig. 3). Nasal bones restricted to the ossified canal, without lateral lamella. Parietal fontanel limited anteriorly by frontals. Parietal branch of supraorbital canal absent.



**FIGURE 3.** Head dorsum of *Characidium helmeri*, MBML 531, 30.1 mm SL, rio Trancoso, Bahia, Brazil. Arrow indicates vestigial supraorbital.

Dentary teeth in two rows; outer series with 6(6), 7(23), 8\*(16) or 9(4) teeth, anterior tricuspid, 3 or 4 posterior unicuspid; teeth decreasing in size from symphysis; inner series with 9(2) or 12(1) several minute conical teeth inserted on edge of replacement tooth trench. Premaxilla with single series of 5(3), 6\*(29), or 7 (14) conical teeth, decreasing in size from symphysis. Maxillary edentulous. Ectopterygoid with a single series of 8(1) or 9(1) conical teeth. Mesopterygoid teeth absent.

Scales cycloid; *circulii* absent and around 10 *radii* present on exposed portion of scales. Lateral line reduced; perforated scales 13\*(7), 14(8), 15(6), 16(3), 17(7), 18(7), 19(2), 20(1), 22(1); total scales along longitudinal line 30(2), 31(12), 32\*(22) or 33(5); horizontal scale rows above lateral line 4\*(43); horizontal scale rows below lateral line 4\*(43). Scales along middorsal line between supraoccipital and origin of dorsal fin around nine or ten, but usually irregularly arranged. Scale rows around caudal peduncle 13 (1) or 14\*(40). Isthmus with anteriormost small portion without scales. Pseudotympanum represented by muscular hiatus at vertical through anterior portion of swimbladder and situated over rib of fifth vertebra (Fig. 4).



**FIGURE 4.** Pseudotympanum of *Characidium helmeri*, MZUSP 112666, 24.9 mm SL, rio Ribeirão, tributary of rio Cahy Braço Norte, Bahia, Brazil.

Dorsal-fin rays ii,9(3), ii,10(12), iii,9\*(25) or iii,10(2); distal margin of dorsal fin rounded. Adipose fin absent. Pectoral-fin rays 8–12 total rays, number of unbranched rays highly variable; unbranched anterior rays ii(2), iii(7), iii\*(8), iv(28), ix(1) and posteriormost rays varying from by 1–4 unbranched; one specimen with all rays unbranched; number of branched rays ontogenetically variable, increasing in number with size; first and second branched pectoral-fin rays usually longest; posterior tip of pectoral fin extending beyond pelvic-fin insertion. Pelvic-fin rays highly variable, i,4,iii(1), i,4,iv (1), i,5,i (1), i,5,ii(6), i,5,iii(6), i,6,i(10), i,6,ii(7), ii,6,ii(1), i,7(1), i,7,i\*(7), or i,8,i(1); second to fourth branched pelvic-fin rays longest; posterior tip of pelvic fin extending beyond anal-fin origin and usually reaching base of second branched anal-fin ray. Anal-fin rays ii,5(1) or ii,6\*(42); iii,6(1); posterior margin of anal fin pointed posteriorly, with second branched usually longest; fin elements (i.e., adnate rays) on last pterygiophore 2\*(43). Caudal-fin rays i,8,8,i(1), i,9,8,i(2). Dorsal procurrent caudal-fin rays 7(3); ventral procurrent caudal-fin rays 6(2) or 7(1).

Total number of vertebrae 33(1), 34(1) or 35(1); precaudal vertebrae 18(1) or 19(2); caudal vertebrae 15(2) or 16(1). Supraneural bones 4(1), 5(1) or 6(1). Epural bones 3(3). Uroneural bone 1(3). Branchiostegal rays 5(3); 4 connected to anterior ceratohyal, 1 connected to the posterior ceratohyal.

**Color in alcohol.** Ground color of head and body pale yellow (Fig. 1). Dark stripe extending from snout to posterior margin of opercle. Dorsum of head with a large brown blotch posteriorly, occupying area from vertical through posterior margin of orbit to posterior margin of the supraoccipital bone. Ventral half of head clear, with sparse small melanophores. Dark midlateral stripe usually extending from rear of opercle to end of caudal peduncle; in some specimens stripe faded or absent. Dark humeral blotch absent. Basicaudal black spot well defined. Presence, form, and arrangement of blotches or bars on laterals of body variable. Most specimens with dorsal half of body with 7 to 10 usually inconspicuous dark primary vertical bars, broader dorsally (2 or 3 scales

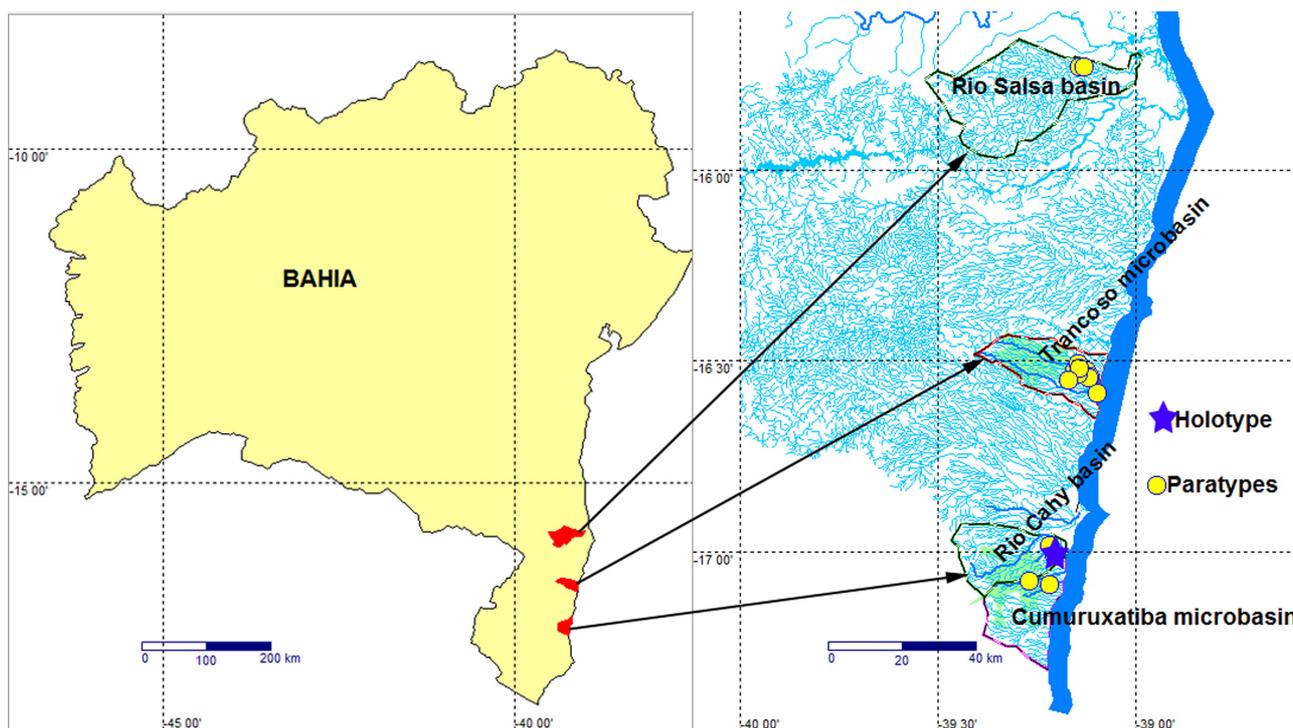
wide); dark and conspicuous narrow dark bars or traces vertically elongate, associated or not to the primary bars, usually more defined over longitudinal band and extending irregularly ventrally; bars on ventral half of body, when present, usually formed by high concentration of dark pigment on posterior half of scales, resulting in curved or somewhat zigzag-shaped spots or dashes, usually not reaching the midventral line of body; posterior half of body usually with vertical bars similarly shaped on dorsal and ventral half, continuous throughout midventral line. In some middle-sized or larger specimens (28.0–36.0 mm SL), spots on dorsolateral area isolated from those distributed over midlateral band and from those more ventrally positioned (when present), resulting in two or three series of spots somewhat horizontally arranged on lateral of body. Smaller specimens, up to 25.0 mm SL, usually with 10–12 continuous narrow vertical bars crossing the sides of the body; bars reaching its contralaterals ventrally on portion posterior to the pelvic fins. Dorsal, anal and caudal fins with melanophores distributed over rays; interradiar membranes mostly transparent, except for a black bar near base of dorsal and anal fins. Pectoral and pelvic fins usually without pigmentation but some specimens with melanophores on fin rays.

**Color in life.** Ground color of dorsal half of yellowish and ventral half whitish (Fig. 2). Pattern of dark spots and bars similar to specimens in alcohol; dark longitudinal stripe and spots on ventral half of body usually more evident than pigmentation on dorsal half. Fins yellowish.

**Etymology.** The specific name, *helmeri*, is a genitive noun in honor of Dr. José Luis Helmer, who collected part of the material of the species, and in recognition of his pioneer studies on the natural history of the freshwater fishes in Espírito Santo and Southern Bahia, since 1976.

**Sexual dimorphism.** No hooks on fins or other sexually dimorphic features were observed externally on specimens examined.

**Distribution.** *Characidium helmeri* is known from various small coastal rivers in Southern Bahia (Fig. 5), in the vicinity of Canavieiras, Porto Seguro, and Prado.



**FIGURE 5.** Map of small coastal river drainages between Cumuruxatiba and Canavieiras, southern Bahia, northeastern Brazil, showing distribution of the new species (blue star represents type locality).

**Habitat and ecological notes.** *Characidium helmeri* is apparently restricted to slow flowing river stretches, situated 8–91m above sea level, a few centimeters to 1.5 m deep, with transparent or dark water running in substrate composed by pebbles, gravel, or organic debris (Fig. 6). The riparian vegetation is composed by secondary forest, with plenty floating meadows and submersed vegetation in portions of the river bank. The new species was collected syntopically with *Aspidoras virgulatus* Nijssen & Isbrucker, *Astyanax* sp., *Geophagus brasiliensis* (Quoy & Gaimard), *Hoplerythrinus uniaeniatus* (Agassiz), *Hoplias malabaricus* (Bloch),

*Mimagoniates microlepis* Steindachner, *M. sylvicola* Menezes & Weitzman, *Scleromystax prionotos* (Nijssen & Isbrucker), *Otothyris travassosi* Britski & Schaefer, *Phalloceros ocellatus* Lucinda, including the endangered species *Acentronichthys leptos* Eigenmann & Eigenmann and *Rachoviscus graciliceps* Weitzman & Cruz. The stomach contents of four specimens of *C. helmeri* analyzed (26.8–35.9 mm SL) contained small aquatic insect larvae, mainly Chironomidae, nymphs, fragments of insects, vegetable debris and organic matter partially digested.



**FIGURE 6.** Type locality of *Characidium helmeri*, new species: rio Ribeirão, rio Cahy basin, Bahia, Brazil.

## Discussion

Weitzman & Vari (1988) suggested as miniature a South American fish that satisfies either of the following two criteria: a species that becomes sexually mature under 20.0 mm SL and may sometimes reach larger sizes; or a species for which maturity data are unknown but that are not reported to exceed 25 to 26 mm SL in the wild. *Characidium helmeri* fits the first criterion, although grows larger than the size proposed in the second. The smallest mature male examined measured 17.5 mm SL, the smallest female with mature oocytes measured 21.5 mm SL, and the largest specimen examined is 40.7 mm SL. Along with small size of maturation, the new species also has some apparent paedomorphic features, such as reduced lateral line, absence of adipose fin, absence of parietal branch of the supraorbital canal, and absence or drastic reduction of the supraorbital bone. Among the Characidiinae, Weitzman & Vari (1988) listed miniaturization events in *Elachocharax*, *Klausevitzia*, *Characidium bahiense* and *Microcharacidium eleotrioides*, suggesting three independent miniaturization events. Based on a phylogenetic hypothesis, Buckup (1993a) listed 11 miniature species within Characidiinae, including *C. bahiense*, and corroborated the hypothesis that miniaturization events occurred three times within the subfamily. The author recognized at least eight reductive characters important to define relationships within the subfamily: (1) loss of adipose fin, (2) reduction or complete loss of parietal branch of supraorbital canal, (3) reduction of lateral line, (4)

possibly loss of maxillary teeth, (5) loss of posterior process of the coracoid, (6) reduction in number of pectoral and caudal-fin rays, (7) loss of tooth cusps, (8) loss of bones as supraorbitals, postcleithrum 1 and uroneurals. The first three characters are shared by a group of species of *Characidium*, including *C. helmeri*, and were previously proposed as synapomorphic for clades of *Characidium* (Buckup & Reis 1997; Netto-Ferreira *et al.* 2013). The absence of the parietal branch of supraorbital canal was proposed as synapomorphic for clade C4 of Buckup (1993a), composed of *C. bahiense*, *C. interruptum*, and *C. lanei*, and more recently by Netto-Ferreira *et al.* (2013) for a more inclusive clade composed of *C. bahiense*, *C. interruptum*, *C. lagsantense*, *C. lanei*, *C. laterale*, *C. mirim*, *C. nupelia*, *C. occidentale*, *C. orientale*, *C. rachovii*, *C. stigmosum*, *C. vestigipinne*, and *C. xavante*. However, a second synapomorphy proposed by the authors for the clade, absence of the inner row of teeth on dentary, is not shared with *C. helmeri*. Furthermore, the new species does not share a distinct increase in the number of vertical bars on the sides of the body, previously proposed as synapomorphic by Buckup & Reis (1997) and Buckup & Hahn (2000) for components of the C4 clade.

The reduction of number of pored scales in lateral line, with less than 15 pored scales, was considered both by Buckup and Reis (1997) and Netto-Ferreira *et al.* (2013) as a synapomorphy for a subclade comprising *C. bahiense*, *C. interruptum*, and *C. rachovii*, although with reversion in *C. occidentale* and *C. orientale*. *Characidium helmeri* also shares with these species reduction in lateral line, although with a comparatively higher number of pored scales (13–22). According to Netto-Ferreira *et al.* (2013) absence of adipose fin, observed also in all specimens of *C. helmeri*, is a homoplastic character supporting a clade containing *C. nupelia*, *C. mirim*, *C. occidentale*, *C. orientale*, *C. rachovii*, *C. stigmosum*, *C. xavante*, *C. vestigipinne*, with reversion in *C. occidentale* and *C. orientale*. The new species does not share the characters used previously by Buckup & Hahn (2000) to group *C. occidentale*, *C. orientale*, *C. rachovii*, and *C. vestigipinne*: dark band along distal margin of anal and pelvic fins in adult male, enlarged anal fin with rounded distal profile in adult males, and fins brightly colored with orange and red chromatophores in live adult males. Also, *C. helmeri* does not have hooks on pectoral- and pelvic-fin rays of males described by Graça *et al.* (2008) in *C. lagsantense*, *C. nupelia*, and *C. xavante*.

Presence or absence of a supraorbital bone was previously used by Buckup (1993a) to define relationships among characidiins and loss of the ossification was synapomorphic for Clade 8, including *Microcharacidium* and *Odontocharacidium*. In *C. helmeri*, the supraorbital is extremely reduced or absent (Fig. 3), a condition distinct from congeners that shares other reductive characters discussed above. No recent information about the absence of the supraorbital among species of *Characidium* is available in the literature and this character deserves future investigation among congeners. Another possible reductive character present in *C. helmeri* is the high number of unbranched pectoral-fin rays replacing the branched rays. One specimen of 23.0 mm SL has all pectoral-fin rays unbranched and the others usually have 3 or 4 rays first rays unbranched, followed by 2–6 (usually 3 or 4) branched and last 3–4 rays unbranched. Netto-Ferreira *et al.* (2013) associated presence of all pectoral-fin rays unbranched in most specimens of *C. mirim* to the small body size of the species. Thus, high number of unbranched rays in *C. helmeri* may represent another reductive character for the species.

Although sharing the apparently reductive characters discussed above, positioning of *Characidium helmeri* among congeners and definition of independent origin of reductive characters present in the new species awaits future studies. When discussing occurrence of the same reductive characters in different congeners, Buckup (1993a) reaffirmed that a cladistic analysis of all characters is the only means to evaluate the relative contributions of different types of features. A phylogenetic analysis including *C. helmeri* along with large number of congeners and a broad array of characters is desirable.

*Characidium helmeri* is a slow water current dwelling fish and does not possess adaptations cited by Buckup *et al.* (2000) for congeners that inhabit fast water current environments, such as a streamlined body and paired-fin modifications. The pectoral- and pelvic fins of *C. helmeri* are not distinctly enlarged and the rays are similar overall, with no thicker or shorter ray segments as observed in *C. timbuiense*. Rather, somewhat fragile paired fins are observed in the new species and congeners that inhabit more lentic environments, as *C. bahiense*, *C. bimaculatum*, and *C. samurai*. *Characidium helmeri* inhabits small coastal river drainages along coastal tablelands in southern Bahia. Together with *Atlantirivulus depressus* (Costa), *Ituglanis cahyensis* Sarmiento-Soares, Martins-Pinheiro, Aranda & Chamon, *Mimagoniates sylvicola*, *Rachoviscus graciliceps*, and *Phalloceros mikrommatos* Lucinda, the species is regionally endemic, occurring in streams with litter bed or acidic waters, conditions usually associated to remnants of the Atlantic Forest. Two of these endemic species, *M. sylvicola* and *R. graciliceps*, are listed as endangered, losing their habitat mainly due to deforestation (Rosa & Lima, 2008). Attention should be

given to the preservation of the small coastal rivers along southern Bahia, in view of the high endemic nature of the area and already threatened fish fauna.

**Comparative material examined.** All listed specimens are alcohol-preserved (except when noted). Brazil. *Characidium alipioi*: MNRJ 5550, holotype, 50.0 mm SL, Rio de Janeiro, rio Paraíba do Sul basin; MNRJ 5551, paratype, 51.0 mm SL; MNRJ 5552, paratype, 48.3 mm SL; MNRJ 5553, paratype, 45.0 mm SL. MZUSP 112331, 6, 50.3–72.3 mm SL, São Paulo, rio Paraíba do Sul basin. MZUSP 80224, 12, 36.5–61.9 mm SL, Rio de Janeiro, rio São João basin. *Characidium bahiense*: MZUSP 8940, holotype, 16.0 mm SL, Bahia, Arembepe; MZUSP 8923, paratype, 18.7 mm SL; MZUSP 8924, paratype, 21.5 mm SL. UFBA 2882, 6, 18.4–24.0 mm SL; UFBA 2886, 4, 19.1–22.0 mm SL, Bahia, rio Inhambupe basin. UFBA 4348, 18, 18.0–24.1 mm SL, Bahia, rio Paraguaçu basin. UFBA 4685, 20, 17.2–22.2 mm SL, Bahia, rio Capivara basin. UFBA 7167, 23, 3 CS, 21.1–26.0 mm SL, Bahia, rio Itapicuru basin. *Characidium bimaculatum*: MNRJ 21249, 14, 20.5–41.4 mm SL, Ceará, rio Curu basin. MNRJ 4925, 1, 25.5 mm SL; MNRJ 4928, 1, 28.7 mm SL, Ceará, rio Salgado basin. MNRJ 4959, 1, 23.2 mm SL; MNRJ 4964, 1, 28.8 mm SL. MNRJ 4975, 1, 29.4 mm SL, Ceará, rio Cotuí. MZUSP 1107779, 8, 29.4–24.3 mm SL, Paraíba, rio Acaraú basin. UFBA 3829, 6, 1 CS, 22.5–30.8 mm SL, Paraíba, rio Piranhas basin. *Characidium* cf. *bimaculatum*: MNRJ 23752, 3, 22.2–24.1 mm SL, Bahia, rio Paraguaçu basin. MNRJ 22424, 21, 27.8–42.3 mm SL, Bahia, rio Jequiriçá basin. *Characidium* cf. *declivirostre*: MZUSP 97137, 1, 35.4 mm SL, Pará, rio Xingu basin. MZUSP 82084, 2, 44.5–46.5 mm SL, Mato Grosso, rio Juruena basin. *Characidium fasciatum*: MZUSP 39676, 15, 32.7–36.4 mm SL, Minas Gerais, rio São Francisco basin. *Characidium gomesi*: MZUSP 73193, 47, 25.8–32.0 mm SL, Minas Gerais, rio Paranaíba basin. MZUSP 88440, 3, 29.5–42.8 mm SL, São Paulo, rio Corumbataí. *Characidium grajahuensis*: MNRJ 3855, holotype (snout damaged, precise measurement currently not possible), Rio de Janeiro, Grajaú. *Characidium hasemani*: MZUSP 91785, 4, 44.0–58.0 mm SL, Mato Grosso, rio Xingu basin. *Characidium heirmostigmata*: MZUSP 97738, holotype, 34.6 mm SL, Paraná, rio Paraná basin. *Characidium interruptum*: MZUSP 58992, 1, 30.9 mm SL, Rio de Janeiro, rio São João basin. *Characidium japuhybense*: MNRJ 5194, holotype (snout damaged, precise measurement currently not possible), Rio de Janeiro, Angra dos Reis. *Characidium lagsantense*: MNRJ 3852, holotype (snout damaged, precise measurement currently not possible), Minas Gerais, rio São Francisco basin. MNRJ 18108, 71, 11.2–31.2 mm SL, Minas Gerais, rio São Francisco basin. *Characidium lanei*: MNRJ 6185, holotype, 40.8 mm SL, São Paulo, rio Ribeira do Iguape basin; MNRJ 9766, paratype, 36.2 mm SL. MNRJ 32884, 38, 20.9–36.4, São Paulo, rio Lajeado. MZUSP 69585, 7, 25.2–31.0 mm SL, São Paulo, rio Ribeira do Iguape basin. *Characidium laterale*: MZUSP 90204, 2, 20.6–25.1 mm SL, Mato Grosso, rio Paraguai basin. MZUSP 96687, 80, 15.7–24.0 mm SL, Mato Grosso, rio Paraguai basin. *Characidium lauroi*: MNRJ 5529, holotype, 60.4 mm SL, Rio de Janeiro, rio Paraíba do Sul basin; MNRJ 5530, paratype, 56.8 mm SL. MZUSP 110359, 5, 31.1–45.9 mm SL, São Paulo, rio Paraíba do Sul basin. *Characidium nupelia*: MZUSP 87743, holotype, 29.0 mm SL, Mato Grosso, rio Paraguai basin. *Characidium oiticicai*: MNRJ 9480, holotype, 35.3 mm SL, São Paulo, rio Tietê basin. MZUSP 108640, 2, 37.4–38.1 mm SL, São Paulo, rio Tietê basin. *Characidium* cf. *pteroideus*: MZUSP 85653, 81, 16.3–28.7 mm SL, Amazonas, rio Negro basin. *Characidium pterostictum*: MZUSP 43547, 15, 28.7–37.8 mm SL, Rio Grande do Sul, Mampituba system. *Characidium rachovii*: MZUSP 49163, 8, 25.9–34.2 mm SL, Rio Grande do Sul Lagoa dos Patos drainage. *Characidium samurai*: MZUSP 108188, holotype, 46.6 mm SL, Bahia, rio das Almas basin; MZUSP 112385, paratypes, 9, 1 mol, 25.4–42.7 mm SL; UFBA 7259, paratypes, 7, 20.8–42.6 mm SL, collected with holotype. MNRJ 40727, paratypes, 4, 31.6–39.2 mm SL; UFBA 5971, 9, 2 CS, 29.3–40.9 mm SL, Bahia, rio das Almas basin. MZUSP 111239, paratypes, 5, 1 CS, 1 mol, 28.1–42.6 mm SL, Bahia, rio das Almas basin. UFBA 5726, paratypes, 3, 26.4–31.3 mm SL, Bahia, rio das Almas basin. UFBA 7258, paratypes, 5, 27.9–34.0 mm SL, Bahia, rio Vermelho basin. *Characidium stigmatosum*: MZUSP 40804, holotype, 33.5 mm SL, Goiás, rio Tocantins basin. *Characidium tenue*: MZUSP 63803, 6, 31.0–42.2 mm SL, Rio Grande do Sul, rio Jacuí basin. *Characidium timbuiense*: MNRJ 4285, holotype, 51.8 mm SL, Espírito Santo, rio Timbuí basin. MNRJ 4284, paratype, 56.9 mm SL; MNRJ 4292, paratype, 53.1 mm SL; MNRJ 4315, paratype, 48.8 mm SL. UFBA 6506, 6, 1 CS, 27.9–44.0 mm SL, Espírito Santo, rio Timbuí basin. *Characidium* aff. *timbuiense*: MZUSP 54826, 5, 32.3–51.9 mm SL, Bahia, rio do Sul basin. MZUSP 112052, 12, 31.6–53.5 mm SL, Bahia, rio de Contas basin. MZUSP 112436, 13, 34.0–48.3 mm SL, Bahia, rio Una basin. MZUSP 112738, 10, 28.2–54 mm SL, Bahia, rio Almada. *Characidium vidali*: MNRJ 9757, holotype, 47.8 mm SL, Rio de Janeiro, rio Soberbo. *Characidium xavante*: MZUSP 87745, paratypes, 20, 13.9–22.7 mm SL, Mato Grosso, rio Xingu basin. *Characidium* cf. *zebra*: MZUSP 92910, 7, 26.5–29.0 mm SL, Amazonas, rio Negro basin. MZUSP 98203, 11, 26.5–31.4 mm SL, Mato Grosso, rio Xingu basin. MZUSP 85091,

2, 52.0–57.8 mm SL, Amazonas, rio Negro basin. MZUSP 101202, 31, 25.2–43.0 mm SL, Bahia, rio Paraguaçu basin. UFBA 5742, 23 (25.1–34.5 mm CP), Bahia, rio Jaguaripe basin. UFBA 5825, 35 (23.3–45.9mm CP), Bahia, rio das Almas basin. *Characidium* sp.: MNRJ 22424, 21, 27.8–42.3 mm SL; MNRJ 23756, 2, 22.2–25.6 mm SL; MNRJ 23758, 1, 30.1 mm SL, Bahia, rio Jequiriçá basin. MNRJ 23752, 3, 22.2–24.1 mm SL; MNRJ 23755, 1, 24.6 mm SL; MNRJ 23757, 2, 21.2–22.5 mm SL; MNRJ 23764, 1, 20.3 mm SL, Bahia, rio Paraguaçu basin. MNRJ 31951, 3, 40.5–51.6 mm SL; MNRJ 31973, 33, 29.9–42.0 mm SL, Bahia, rio Corumbau basin. MZUSP 100772, 11, 23.4–34.4 mm SL, Bahia, rio Paraguaçu basin. MZUSP 112697, 3, 42.6–52.6, Bahia, rio Pardo basin. MZUSP 112736, 18, 26.3–48.8 mm SL; MZUSP 112738, 19, 28.1–53.9 mm SL, Bahia, rio Almada basin. Peru. *Characidium* cf. *zebra*: MZUSP 77838, 2, 23.5–27.1 mm SL, Loreto, rio Pastaza basin. Venezuela. *Characidium* cf. *zebra*: MZUSP 96477, 1, 35.0 mm SL, Bolivar, Rio Orinoco basin.

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