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A new species of *Characidium* Reinhardt, 1867 (Characiformes: Crenuchidae) endemic to the Atlantic Forest in Paraná State, southern Brazil

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A new species of *Characidium* is described based on specimens obtained from the highland streams of the Serra do Mar, Atlantic Forest Biome, in Paraná State, Southern Brazil. The new species is possibly a member member of the *C. lauroi* group, which is diagnosed by having the isthmus unscaled, bars poorly marked, and spots on sides of body, and is composed by four additional species: *C. japuhybense*; *C. lauroi*; *C. oiticicai*; and *C. schubarti*. The new species differs from its congeners with naked isthmus, except *C. helmeri*, by having 15-18 principal caudal-fin rays; and 10-12 pectoral-fin rays; and from *C. helmeri*, by having a slender body, tip of pectoral fin not reaching origin of pelvic fin, tip of pelvic fin not reaching beyond anus, supraorbital present and well developed, and by lacking vertically elongated dashes on sides of body. The new species is known from tributaries of the rio Jordão, in the rio Iguaçu Basin, and rio Taquari, a tributary of the rio Ribeira de Iguape coastal drainage.

Uma nova espécie de *Characidium* é descrita com base em exemplares obtidos de riachos de altitude da Serra do Mar, no bioma Mata Atlântica, do Estado do Paraná, Sul do Brasil. A nova espécie é possivelmente um membro do grupo *C. lauroi*, que pode ser diagnosticado por possuir o istmo sem escamas, barras pouco marcadas e pontos nos lados do corpo, e é composto por quatro espécies adicionais: *C. japuhybense*; *C. lauroi*; *C. oiticicai*; e *C. schubarti*. A nova espécie difere de seus congêneres com istmo nú, exceto *C. helmeri*, por possuir 15-18 raios principais na nadadeira caudal, e 10-12 raios na nadadeira peitoral; e de *C. helmeri*, por possuir o corpo mais alongado, pela ponta da nadadeira peitoral não alcançar a nadadeira pélvica, pela ponta da nadadeira pélvica não alcançar o ânus, pelo supraorbital presente e bem desenvolvido, e pela ausência de manchas verticalmente alongadas na porção ventral do corpo. A nova espécie é conhecida de duas drenagens, nos tributários do rio Jordão, na bacia do rio Iguaçu, e no rio Taquari, um tributário da bacia costeira do rio Ribeira de Iguape.

Keywords: *Characidium lauroi* group, Mata Atlântica, Rio Iguaçu, Rio Ribeira de Iguape, South American Darters.

Introduction

Species of *Characidium* Reinhardt, 1867 are typical inhabitants of the small to medium-sized streams in the Neotropical Region, from eastern Panama to northern Argentina (Buckup, 1993b; Buckup, 1999). *Characidium* currently includes 66 valid species, including a new species described herein (Eschmeyer *et al.*, 2016). Thirteen species are endemic to the streams of the Serra do Mar Ecorregion, in the Atlantic Forest Biome (*sensu* Scaramuzza *et al.*, 2011): *C. alipioi* Travassos, 1955; *C. grajahuense* Travassos, 1944; *C. interruptum* Pellegrin,1909; *C. japuhybense* Travassos, 1949; *C. lanei* Travassos, 1967; *C. lauroi* Travassos, 1949; *C. litorale* Leitão & Buckup, 2014; *C. oiticicai* Travassos, 1967; *C. pterostictum* Gomes, 1947; *C. schubarti* Travassos, 1955; *C. timbuiense* Travassos , 1946 and *C. vidali* Travassos, 1967 (Menezes *et al.*, 2007; Leitão & Buckup, 2014).

Herein we describe a new species of *Characidium*, only known from a few localities in Paraná State: the tributaries of rio Jordão, a tributary of the right bank of rio Iguaçu, rio Paraná-Basin; and the rio Capivari, in the southern part of the rio Ribeira de Iguape, a coastal drainage. The new species is hypothesized as a member of the *C. lauroi* group of species. The *C. lauroi* group is composed by four additional species, endemic to the clear water streams of the Serra do Mar between Paraná and Rio de Janeiro States: *C. japuhybense* Travassos, 1949, from the coastal drainages in São Paulo and Rio de Janeiro; *C. lauroi* Travassos, 1949, from the tributaries of the upper and middle rio Paraíba do Sul; *C. oiticicai* Travassos, 1967, from the upper rio Tietê and rio Ribeira de Iguape; and *C. schubarti* Travassos, 1955, from the headwaters of rio Paranapanema and rio Ribeira de Iguape (Travassos, 1949a, 1949b, 1955a, 1967; Bizerril & Primo, 2001; Buckup & Melo, 2002; Oyakawa *et al.*, 2006).

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Materials and Methods

Morphometric and meristic data were obtained from the left side of specimens, under a binocular stereomicroscope, according to Buckup (1993a) and Melo & Oyakawa (2015). Measurements were taken using a digital caliper to 0.1 mm. Counts are listed in the text, followed by their frequencies in parentheses; an asterisk indicates the value for the holotype. Osteological characteristics were observed in cleared and stained specimens (cs), which were prepared according to Taylor & Van Dyke (1985). Terminology for caudal-fin elements follows Fujita (1990), the vertebral counts included the five anterior-most elements modified into the Weberian apparatus counted individually, but the urostyle was counted as a single element, and the supernumerary elements in dorsal and anal fins were counted only from cleared and stained individuals. Institutional abbreviations follow ASIH codes listed at http://asih.org/codons.pdf.

Results

Characidium travassosi, new species

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Figs. 1 a-e and 3 a-c, Table 1

Characidium sp. *"iguaçu"*. -*Melo*, 2001: 39-41, figures 5b, 12; table 6.
Characidium sp. 2. -Baumgartner *et al*., 2012: 71.
Characidium sp. B. -Severi & Cordeiro, 1994: 47-48.

Holotype. MZUSP 85940, 33.8 mm SL, Brazil, Paraná, Reserva do Iguaçu, rio das Torres, a small tributary of rio Jordão, rio Iguaçu basin, 38 km southeast of Pinhão, 25º48'28"S, 51º59'01"W, 10 Jan 2001, C. R. Moreira.

Paratypes. All from Brazil, Paraná: MCP 22605, 11 (2 cs), 23.0-51.4 mm SL, Guarapuava, arroio [rio Pai João] tributary of rio Jordão, rio Iguaçu basin, at Km 386 of road BR-373, towards the locality of Laranjeiras do Sul, between Guarapuava and Lagoa Seca, 25º26'24"S 51º50'08"W, 5 Jul 1998, C. A. S. Lucena *et al.* MCP 22606, 1, 44.1 mm SL, border between Candói and Guarapuava, rio Campo Real, tributary of rio Jordão, rio Iguaçu basin, at road BR-373, 25º25'07"S 51º46'55"W, 05 Jul 1998, C. A. S Lucena *et al.* MNRJ 36865, 11, 26,8-41,8 mm SL; and MNRJ 36866, 50, 18.9-27.8 mm, Garapuava, small stream tributary of rio Jordão, rio Iguaçu basin, at Km 383 of road BR-373, 25º26'03"S 51º 48'34"W, 16 Oct 2009, C. E. Lopes *et al*. MNRJ 21542, 1, 36.1 mm SL, Pinhão, rio das Torres, small tributary rio Jordão, rio Iguaçu basin, 21 Oct 1991, W. B. Wosiacki & A. C. Carrilo. MNRJ 21543, 2, 32.0-57.1 mm SL, collected with MNRJ 21542. MNRJ 40796, 1, 48.2 mm SL, Quatro Barras, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, in front of Morada do Silêncio Chaminé da Serra da Ordem Rosa Cruz, 25º20'18"S, 48º55'41"W, 9 Oct 2012, P. A. Buckup *et al*., MHNCI 8601, 2, 25.4-46.6 mm SL, Pinhão, rio das Torres, a tributary of rio Jordão, rio Iguaçu basin, 21 Oct 1991, W. B. Wosiacki & A. C. Carrilo. MZUSP 85938, 7 (1 cs), 29.7-33.8 mm SL, at the border between Pinhão and Reserva do Iguaçu, rio Quadrado, rio Iguaçu basin, 8 km west of Pinhão along the road PR-459, 25º41'19.3" S, 51º44'38.6" W, 9 Jan 2005, C. R. Moreira. MZUSP 68132, 12, 34.8-42.5 mm SL, Quatro Barras, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, 2 km ahead of Morada do Silêncio Chaminé da Serra da Ordem Rosa Cruz, 25º20'20"S, 48º55'46"W, 10 Mar 2001, O. T. Oyakawa *et al*. MZUSP 68135, 3, 38.7-44.9 mm SL, Quatro Barras, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, 2 km ahead of Morada do Silêncio Chaminé da Serra da Ordem Rosa Cruz, 25º20'42"S, 48º56'12"W, 10 Mar 2001, O. T. Oyakawa *et al*. MZUSP 68136, 8, 32.8-41.4 mm SL, Quatro Barras, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, in front of Morada do Silêncio Chaminé da Serra da Ordem Rosa Cruz, 25º19'54" S, 48º55'36" W, 10 Mar 2001, O. T. Oyakawa *et al*. MZUSP 68140, 13, 44.0-61.1 mm SL, Quatro Barras, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, 2 km à frente do Rosa Cruz, 25º20'42" S, 48º56'14" W, 10 Mar 2001, O. T. Oyakawa *et al.* MZUSP 68142, 25 (2 cs) 32.5-56.8 mm SL, Quatro Barras, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, in front of Morada do Silêncio Chaminé da Serra da Ordem Rosa Cruz, 25º20'20" S, 48º55'44" W, 10 Mar 2001, O. T. Oyakawa *et al*. MZUSP 68144, 16, 33.2-55.1 mm SL, Quatro Barras, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, 2 km ahead of Rosa Cruz, 25º20'42" S, 48º56'14" W, 10 Mar 2001, O. T. Oyakawa *et al.*

Diagnosis. *Characidium travassosi* is a member of Clade C1 (Buckup, 1993b), which can be diagnosed from its congeners, except *C. alipioi*, *C. amaila* Lujan, Agudelo-Zamora, Taphorn, Booth & López-Fernández, 2013, *C. boavistae* Steindachner, 1915, *C. bolivianum* Pearson, 1924; *C. crandellii* Steindachner, 1915; *C. declivirostre* Steindachner, 1915; *C. fasciatum* Reinhardt, 1867; *C. gomesi* Travassos, 1956, *C. lauroi*, *C. grajahuense*, *C. helmeri* Zanata, Sarmento-Soares & Martins-Pinheiro, 2015, *C. japuhybense*, *C. kamakan* Zanata & Camelier, 2015, *C. pterostictum*, *C. oiticicai*, *C. purpuratum* Steindachner, 1882, *C. schubarti*, *C. timbuiense*, and *C. vidali* by having the isthmus unscalled (*vs.* isthmus scaled). *Characidium travassosi* differs from all species included in Clade 1, except *C. helmeri*, by having 15-18 principal caudal-fin rays (*vs.* 19 principal caudal-fin rays), and 10-12 total pectoral-fin rays (*vs.* 13 or more total pectoral-fin rays), and from *C. helmeri* by having the body slender (body depth at dorsal-fin origin 15.9-23.5 *vs.* 23.8-30.9% in SL), tip of pectoral fin not reaching origin of pelvic fin (*vs.* tip of pectoral fin reaching origin of pelvic fin), tip of pelvic fin not reaching beyond anus (*vs.* tip of pelvic fin reaching well beyond anus, to origin of anal fin), supraorbital well

developed (*vs.* supraorbital absent or vestigial), and by basicaudal spot on base of caudal-fin middle rays absent (*vs.* present). Furthermore, the number of pored lateral-line scales in *C. travassosi* is usually higher than in *C. helmeri* (14-35 *vs.* 13-22). *Characidium travassosi* further differs from all species in Clade C1 except *C. japuhybense*, *C. helmeri*, *C. lauroi*, *C. oiticicai*, and *C. schubarti* by the presence of spots or dashes on flank (*vs.* spots absent), and from *C. japuhybense*, *C. helmeri*, *C. lauroi*, *C. oiticicai*, and *C. schubarti* by having spots inconspicuous (Fig. 1a, b, c), triangular, or v-shaped (Fig. 1d, e), sometimes connected in forming w-shaped marks (*vs.* spots stout, small and rounded in *C. japuhybense*, *C. lauroi*, *C. oiticicai* and *C. schubarti*; or spots or dashes stout and vertically elongated in *C. helmeri*). Additionally, *C. travassosi* differs from all species in Clade C1, except *C. helmeri* and *C. oiticicai*, by the absence of the adipose fin (*vs.* adipose fin present; in *C. oiticicai*, the adipose fin can be either absent, reduced or well-developed); and from all species in Clade C1, except *C. helmeri* and *C. schubarti*, by having the unscaled ventral surface restricted to a small area in the isthmus (*vs.* unscaled area extending from the isthmus to the area between the contralateral anterior pectoral-fin rays in *C. japuhybense*, *C. lauroi*, and *C. oiticicai*; unscaled area extending from isthmus, to the breast and around the pectoral fins in *C. alipioi*, *C. amaila*, *C. boavistae*, *C. bolivianum*, *C. fasciatum*, *C. gomesi*, *C. grajahuense*, *C. kamakan*, *C. purpuratum*, *C. pterostictum*, *C. timbuiense*, and *C. vidali*, and unscaled area extending from the isthmus to the belly in *C. crandellii*, and *C. declivirostre*).

Description. Morphometric data summarized in Table 1. Species of *Characidium* reaching 55.1 mm SL. Body fusiform. Dorsal profile moderately convex between tip of snout and dorsal-fin origin, gently arched at dorsal-fin base, almost straight between dorsal and caudal-fin bases. Ventral profile gently convex between anterior tip of dentary and anal-fin origin, slightly convex at anal-fin base; almost straight between anal and caudal-fin bases. Belly more strongly arched in females with ovaries well developed. Greatest depth of body at dorsal-fin origin.

Table 1. Morphometric data for *Characidium travassosi*, new species. Range values are for holotype (MZUSP 85940) and paratypes (MZUSP 68135, n=3; 68140, n=10; 68142, n=10; 68144, n=10; 85938, n=7); N: total number of specimens examined; SD: Standard Deviation.

Character	Holotype	N	Range	Mean	SD
Total length (mm)	42.1	41	35.7-68.8	48.5	
Standard length (mm)	33.8	41	29.7-56.3	39.6	6.3
Percentage of standard length					
Head length	23.8	41	23.8-26.7	25.0	0.8
Prepectoral distance	23.1	41	20.5-25.5	23.1	0.9
Pectoral-fin height	18.3	41	16.8-23.1	19.9	1.5
Predorsal distance	50.0	41	45.2-52.0	48.4	1.3
Dorsal-fin height	15.2	40	11.8-18.5	14.9	1.5
Dorsal-fin base	14.3	41	12.9-16.9	14.6	0.9
Prepelvic distance	52.0	41	46.7-55.2	51.8	1.6
Pelvic-fin height	10.5	41	8.6-14.3	11.7	1.0
Preanal distance	76.8	41	71.9-79.9	75.3	1.7
Anal-apex distance	94.3	41	87.1-100.7	93.6	2.3
Anus to anal-fin distance	3.6	41	2.6-4.7	3.6	0.5
Anal-fin height	13.1	41	10.1-15.8	13.3	1.1
Anal-fin base	8.6	41	6.7-9.8	7.7	0.6
Body width	12.8	41	10.0-13.4	11.5	0.9
Peduncle length	18.9	41	15.2-20.5	17.5	1.1
Body depth at dorsal-fin origin	23.1	41	15.9-23.5	20.0	2.0
Body depth at anal-fin origin	17.5	41	12.2-17.5	14.5	1.2
Body depth at caudal-fin peduncle	12.1	41	10.2-12.5	11.5	0.6
Head length (mm)	8.0	41	7.3-15.0	9.9	1.6
Percentage of head length					
Snout length	23.8	41	19.5-26.3	22.6	1.8
Snout-maxillary tip	25.6	41	23.7-30.2	26.5	1.7
Anterior naris-orbit	8.3	41	6.8-10.6	8.7	0.7
Posterior naris-orbit	4.2	41	2.7-5.0	3.8	0.5
Cheek	10.4	41	6.5-11.3	9.2	1.0
Orbital diameter	25.9	41	22.1-29.4	26.9	1.5
Interorbital diameter	17.5	41	12.5-19.3	15.7	1.7

Snout short, gently rounded, its tip at level of inferior margin of eye. Mouth small, sub-terminal. Snout-maxillary tip distance equal or slightly longer than eye diameter; maxilla reaching level of anterior margin of orbit. Orbit rounded or slightly elongated antero-dorsally; margin of orbit free. Cheek depth about one third of eye diameter. Nares distinctly separated; distance between nares shorter than distance between posterior naris and eye. Dermal flap along entire border of anterior naris, crescent-shaped and restrict to anterior margin of posterior naris. Parietal branch of supraorbital laterossensory canal absent. Fontanel limited anteriorly by frontals, posteriorly by parietals. Dentary teeth in two rows. Outer dentary teeth 5 (4), 7* (6), 8 (10), 9 (14), 10 (2), 11 (3), 12 (1), with three cusps, teeth increasing in size from lateral to medial. Inner dentary teeth in single row of several minute, conical teeth. Premaxillary teeth in single row. Premaxillary teeth 5 (3), 6* (16), 7 (20), 8 (1), with three cusps, teeth increasing in size from lateral to medial. Maxillary teeth absent. Ectopterygoid teeth conical, 9 (2), in single row. Mesopterygoid teeth absent. Branchiostegal rays 5* (41); 4 attached to anterior ceratohyal (2). Gill rakers on first arch 11 (2).

Scales cycloid; parallel radii present on posterior field of scale. Lateral line usually complete; lateral series of scales 33 (1), 34 (15), 35* (19), 36 (4), 37 (1). Perforated scales in lateral line highly variable, 21 (2), 22* (1), 29 (1), 32 (1), 33 (1), 34 (15), 35 (16), 36 (4); some specimens (*e.g.*, MCP 22605, 4 of 4; MHNCI 8603, 1 of 2; MZUSP 85938, 1 of 4) with all scales of lateral series perforated; other specimens (*e.g.*, MCP 22606, 1 of 1; MZUSP 85938, 3 of 4) with only anterior scales perforated; one specimen (MZUSP 85938) with lateral line discontinuous. Scales above lateral line 4 (11), 5* (30). Scales below lateral line 5* (30), 6 (10). Scales around caudal peduncle 13 (3), 14* (38). Pre-dorsal scales series irregularly distributed. Scales on pre-dorsal series 11 (14), 12* (22), 13 (5). Scales between anus and anal fin 2* (38), 3 (3). Isthmus lacking scales to anterior margin of cleithrum.

Pectoral-fin rays ii,6,ii (1), iii,5,ii (1), iii,6,ii (2), iii,7,i (6), iii,7,ii* (13), iii,8,i (11), iii,8,ii (5), iv,7,ii (1), iii,9,i (1). Pelvic-fin rays i,5,i (1), ii,5,i (1), i,6,i* (37), i,7,i (2). Dorsal-fin rays ii,8 (1), iii,8 (3), ii,9* (31), iii,9 (5), ii,10 (1); supranumerary element on first pterygiophore of dorsal fin 1 (1). Anal-fin rays i,6 (1), i,7 (1), ii,5 (4), ii,6* (32), iii,5 (3); supranumerary element on first pterygiophore of anal fin 1 (1). Principal caudal-fin rays i,6,7,i (1), i,7,7,i* (1), i,7,8,i (33), i,8,7,i (4), i,8,8,i (2). Adipose fin absent* (41).

Precaudal vertebrae 20 (2), 21 (1); total vertebrae 35 (1), 36 (1), 37 (1). Upper procurrent rays 6 (3); lower procurrent rays 6 (3). Hypurals 5 (3). Epurals 1 (1), 2 (1), 3 (1). Uroneural 1 (3).

Coloration. Preserved specimens with ground color of head and trunk tan. Cheek, distal portion of upper jaw, and ventral part of head pale; anterior portion of upper jaw, dorsal portion of snout and head brown. Dorsal half of flank darker than ventral; belly pale. Longitudinal stripe stout, extending from tip of snout to postero-dorsal angle of opercle on head, continuing along midbody dorsally to lateral line, not reaching scales on base of caudal-fin rays. Eyes entirely black or with a small light ventral area. Humeral spot oval, vertically elongated, positioned over posttemporal and supracleithrum, overlapped by longitudinal stripe. Spot on base of caudal-fin middle rays absent. Vertical bars on body eight to nine, irregular distributed, and blurry along dorsal midline; not connected ventrally on caudal peduncle and belly. Inconspicuous spots on flank present, variable in position, number and form. Spots usually associated to primary bars, often numerous and present above and below vertical stripe (Fig. 1a, c, d, e), but in some specimens few and restricted to area below vertical stripe (Fig. 1b). Spots inconspicuous (Fig. 1a, b, c), triangular, or v-shaped (Fig. 1d, e), sometimes connected forming w-shaped marks (Fig. 1d, e).

Pelvic and anal-fins rays and interradial membranes hyaline. Pectoral-fin interradial membrane hyaline, and pectoral-fin rays with widely spaced melanophores, more concentrated on first, second, third and, sometimes, fourth, fifth and sixth rays. Dorsal-fin rays and interradial membrane mostly hyaline, except for two longitudinal dark stripes, parallel to fin base. Caudal fin with widely spaced melanophores, more concentrated on fin rays, forming inconspicuous marks. Spot at base medial caudal-fin rays absent.

Sexual dimorphism. No external dimorphism was observed.

Distribution. *Characidium travassosi* is only known from Paraná State, Brazil, in small cold-water creeks of the Mata Atlântica biome. It is known from the streams draining the west side of Serra da Esperança into rio Jordão, a tributary of the right bank of rio Iguaçu, rio Paraná Basin; and from rio Taquari, a small stream at Serra da Graciosa, which runs north into the rio Capivari, in the southern-most portion of the rio Ribeira de Iguape coastal system (Fig. 2).

Etymology. The specific name is dedicated to Haroldo Travassos, a deceased Brazilian ichthyologist, in recognition to the contributions he made for the taxonomy of the genus *Characidium*. Travassos worked at the Brazilian Museu Nacional, and was responsible for the description of 13 species of *Characidium* between 1944 and 1967, mostly from the South and Southeastern Brazil.

Conservation status. Considering that current relevant threats to the species were not detected in its distribution area, *Characidium travassosi* can be classified as Least Concern (LC), according to the International Union for Conservation of Nature categories and criteria (IUCN, 2014).

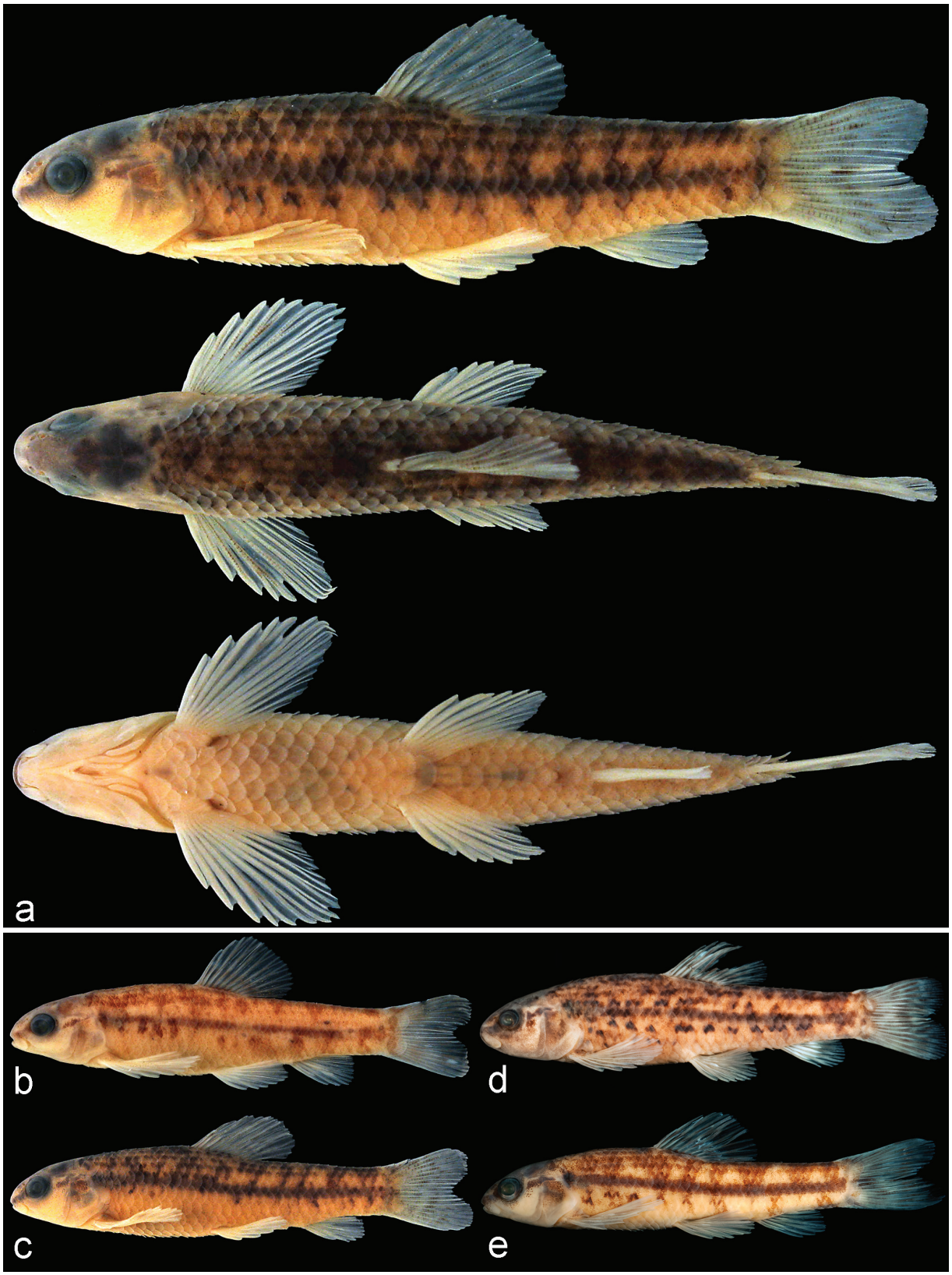

Fig. 1. *Characidium travassosi*, new species: (a) MZUSP 85940, 33.8 mm SL, holotype in lateral, dorsal and ventral views; stream tributary of rio Jordão, rio Iguaçu basin; (b) MZUSP 85938, 32.0 mm SL, and (c) MZUSP 85938, 32.9 mm SL, paratypes, rio Quadrado, rio Iguaçu basin; (d) MZUSP 68142, 56.3 mm SL, paratype, rio Taquari, tributary of rio Capivari, rio Ribeira de Iguape basin, (e) MZUSP 68144, 40.3 mm SL, paratype, rio Taquari tributary of rio Capivari, rio Ribeira de Iguape basin.

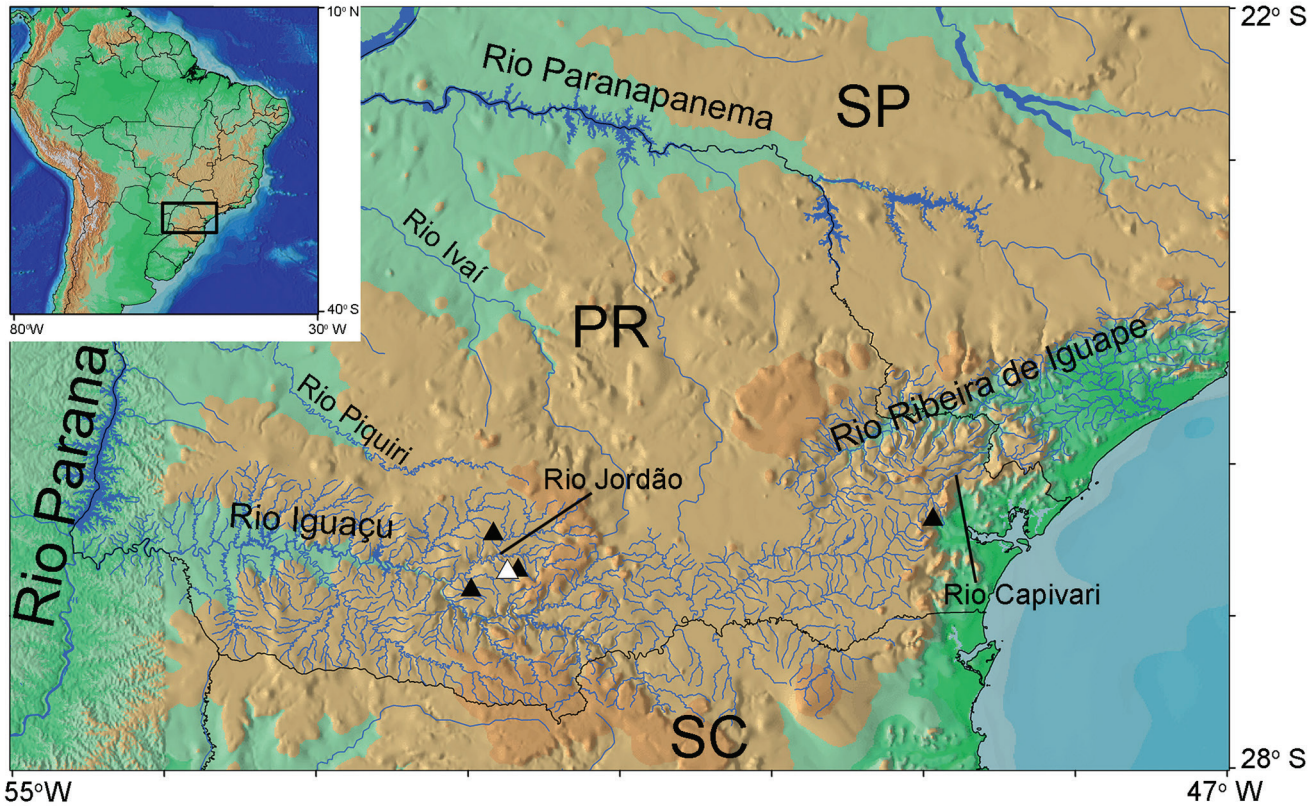

Fig. 2. Geographic distribution of *Characidium travassosi*. White triangle = type locality; black triangles = additional localities.

Discussion

The number of bony elements of the caudal fin is variable in *C. travassosi*, being reduced in some specimens (Fig. 3). The complete condition is to have six hypurals and three epurals supporting the principal caudal-fin rays, and the upper and lower procurrent rays, as in *Characidium fasciatum* (MZUSP 85938, Fig. 3d). Only a few specimens of *C. travassosi* (*e.g.*, MZUSP 88142, Fig. 3a) have such condition, and other specimens have variation, including fusions and losses of caudal-fin bones. The number of epurals varies from one to three, being two the most frequent (*e.g.,* MZUSP 88142 and 85938, Fig. 3b, c). The number of hypurals may be reduced to five or four, but with different combinations: in MZUSP 85938, the hypural four or five is missing or fused (Fig. 3c), and in MZUSP 88142 the hypurals one and two, and hypurals three and four are clearly fused (Fig. 3b). The malformation of the caudal-fin bones is correlated with the reduced number of caudal-fin rays.

Reduction in number of caudal-fin rays is a relatively common trend among characidiins, including five species of *Characidium*. *Microcharacidium* Buckup, 1993 includes three miniature species with only 17 principal caudal-fin rays (character 36, state 1 of Buckup, 1993b): *M. eleotrioides* (Géry, 1960), *M. weitzmani* Buckup, 1993, and *M. gnomus* Buckup, 2003. Zarske (1997) erected the genus *Geryichthys* to include *G. sterbai* and suggested a close relationship between *Geryichthys* and *Microcharacidium* based on the low number of caudal-fin rays, pectoral-fin rays, and lateral-line scales. The validity of *Geryichthys*, however, was previously questioned by Graça *et al.* (2008) and, although the species is valid, the genus should be considered as a junior synonym of *Characidium*. *Characidium geryi* was erroneously described as a *Microcharacidium* due to the low number of fin rays, also has 16-17 caudal-fin rays (Zarske, 1997). Other species of *Characidium* with relatively low number of caudal-fin rays are *C. helmeri* with 18-19 caudal-fin rays, *C. mirim* Netto-Ferreira, Birindelli & Buckup, 2013 with 15-17 caudal-fin rays, *C. nupelia* Graça, Pavanelli & Buckup, 2008 with 17-19 caudal-fin rays, and *C. xavante* da Graça, Pavanelli & Buckup, 2008 with 18-19 caudal-fin rays (Graça *et al.*, 2008; Netto-Ferreira *et al.*, 2013; Zanata *et al.*, 2015).

Characidium travassosi also has a low number of pectoral-fin rays (10-12) compared to most of its congeners, which have 13 or more. The smaller range in number of pectoral-fin rays is not a discrete character and, therefore, it is difficult to coded it as a phylogenetic character. It does not seem to unique to any particular group of species of *Characidium*, since the following species also have a low count of pectoral-fin rays: *C. bahiense* Almeida, 1971 has 9-11 pectoral-fin rays; *C. bimaculatum* Fowler, 1941,

with 12 pectoral-fin rays; *C. etzeli* Zarske & Géry, 2001, with 11-12 pectoral-fin rays; *C. geryi*, with 8-9 pectoral-fin rays; *C. heinianum* Zarske & Géry, 2001, with 10 pectoral-fin rays; *C. helmeri*, with 8-12 pectoral-fin rays; *C. mirim*, with 9-11 pectoral-fin rays; *C. nupelia*, with 11-13 pectoral-fin rays; *C. sterbai*, with 9-10 pectoral-fin rays; and *C. xavante*, with 11-13 pectoral-fin rays (Fowler, 1941; Almeida, 1971; Zarske, 1997; Zarske & Géry, 2001; Graça *et al.*, 2008; Netto-Ferreira *et al.*, 2013; Zanata *et al.*, 2015). The species of *Elachocharax*, *Klausewitzia*, *Microcharacidium*, and *Odontocharacidium* have nine or fewer pectoral-fin rays (Buckup, 1993b: Clade 5; character 29).

Absence of an adipose fin is another reductive character widespread within the species of *Characidium*. Besides *C. travassosi*, the adipose fin is absent in *C. helmeri*, *C. mirim*, *C. nana*, *C. nupelia*, *C. stigmosum*, *C. sterbai*, and *C. xavante* (Zarske, 1997; Melo & Buckup, 2002; Graça *et al.*, 2008; Netto-Ferreira *et al.*, 2013; Mendonça & Netto-Ferreira, 2015), reduced or absent in *C. vestigipinne* (Buckup & Hahn, 2000), well-developed or absent in *C. lauroi* (Travassos, 1949a; *Characidium* sp. 1 in Lima, 1997), and well-developed, reduced or absent in *C. oiticicai* (Travassos, 1967; Ribeiro *et al.*, 2006; Marceniuk *et al.*, 2011; our data). The adipose fin is also reduced in *Microcharacidium weitzmani* Buckup, 1993, and absent in *Elachocharax geryi* Weitzman & Kanazawa, 1978, *Poecilocharax bovaliorum* Eigenmann, 1909, and *P. weitzmani* Géry, 1965 (Eigenmann, 1909; Géry, 1977; Weitzman & Kanazawa, 1978; Buckup, 1993a).

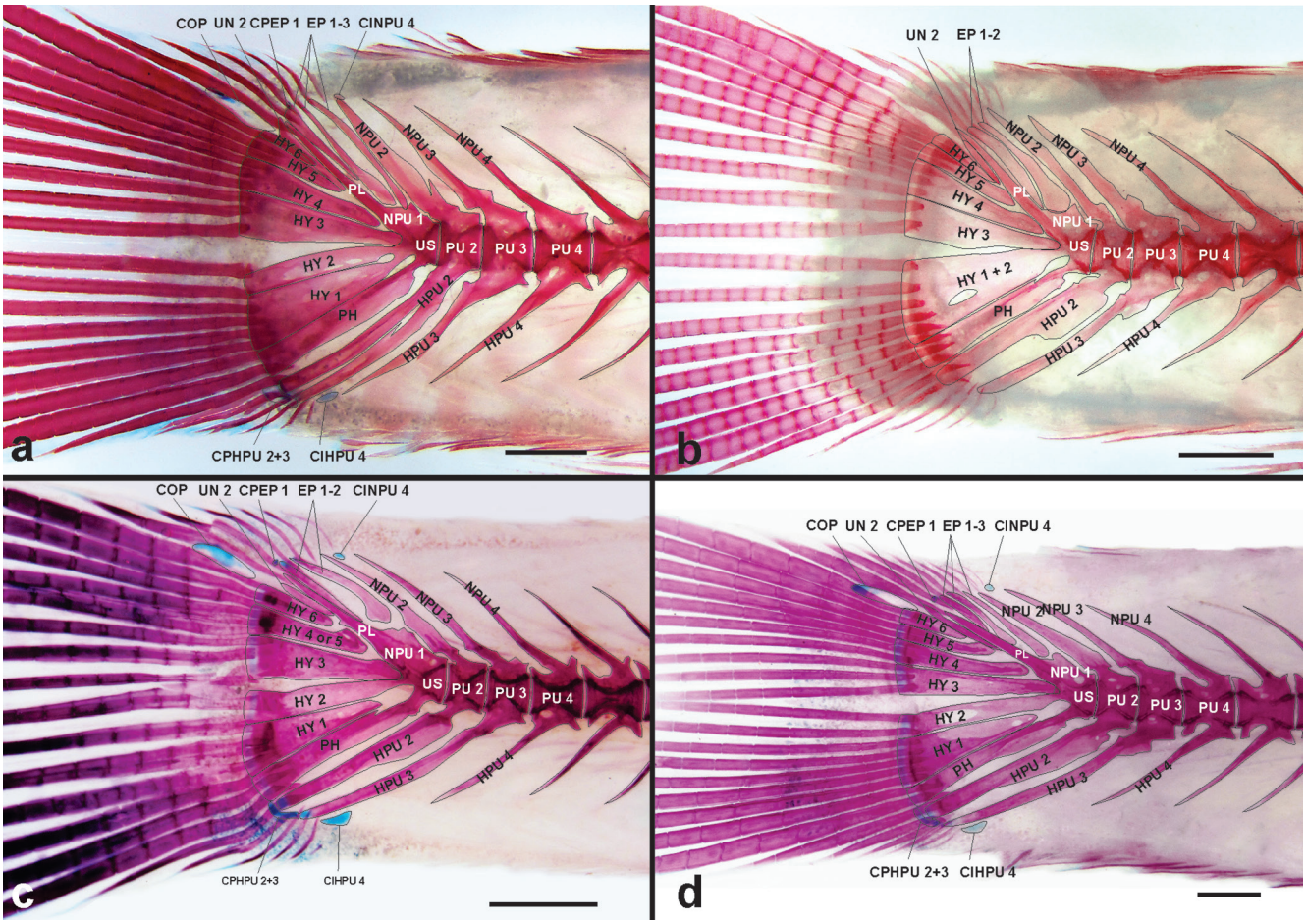

Fig. 3. Caudal-fin bony elements in *Characidium travassosi* (a = MZUSP 88142, 45.0 mm SL; b = MZUSP 68142, 45.6 mm SL; c = MZUSP 85938, 29.8 mm SL), and *Characidium fasciatum* (d = MZUSP 85995, 27.9 mm SL). Scale bar equals 1 mm. Specimens illustrated in a, c and d were double stained for bone and cartilage; specimen b was only stained for bone. The epineurals and epipleurals were removed during dissection; numbering of hypurals does not necessarily imply homology. Abbreviations are as follows: EP, epurals; HPU, haemal spine of pleural centrum; NPU, neural spine of pleural centrum; HY, hypural; NA, neural arch; NU, neural spine of ural centrum; PH, parahypural; PL, pleurostyle; PU, pleural centrum; US, urostyle; CIHPU, inter-neural spine of cartilage of pleural centrum; CPHPU, post-neural spine cartilage of pleural centrum; COP, opisthural cartilage; CPEP, post-epural cartilage; CINPU, inter-neural spine cartilage of pleural centrum.

***Characidium lauroi* group of species.** The group was firstly proposed by Travassos (1955a: 371, 1967: 45), without an explicit diagnosis or establishment of its taxonomic limits. In addition to *C. travassosi*, the *C. lauroi* group includes the following four species: *C. lauroi*, *C. japuhybense*, *C. oiticicai*, and *C. schubarti* (Melo, 2001; Buckup & Melo, 2002).

These species occur in small streams draining the Serra do Mar mountain range from 22º17'S to 25º48'S and 45º15'W to 48º30'W, along the eastern areas of the Brazilian states of Paraná, São Paulo and Rio de Janeiro. *Characidium lauroi* occurs in the tributaries of the Medium and Upper rio Paraíba do Sul drainage; *C. japuhybense*, in coastal streams from the Ilha Grande Bay to the State of São Paulo, including a few isolated populations in the streams of the Ilha Grande and the Ilha de São Sebastião (Ilha Bela); *C. schubarti*, in tributaries of rio Paranapanema; and *C. oiticicai*, in headwaters of rio Tietê. Remarkably, with the exception of *C. lauroi*, all other species of the group also occur in the rio Ribeira de Iguape coastal drainage (Travassos, 1949a, 1949b, 1955a, 1967; Oyakawa *et al.*, 2006; Scaramuzza *et al.*, 2011; Lima, 1997; Ribeiro *et al.*, 2006; Marceniuk *et al.*, 2011; our data)

Characidium lauroi group is characterized by three derived characteristics: parietal branch of supraorbital sensory canal absent; vertical bars irregular distributed, fainted or absent, not connected ventrally in caudal peduncle; and presence of small spots on the ventral portion of flank. Although those characteristics represent putative synapomorphies, the absence of the parietal branch, and the poorly marked vertical bars are not unique to the *C. lauroi* group. The presence of dots on sides of body, however, is very characteristic and unique to the group.

The parietal branch of supraorbital sensory canal is also absent in the species included in Clade 4, and in the all species included in the genera *Elachocharax*, *Microcharacidium*, and *Odontocharacidium* (Buckup, 1993b; Melo & Buckup, 2002; Netto-Ferreira *et al.,* 2013; Mendonça & Netto-Ferreira, 2015). This character distribution indicates that this character probably evolved multiple, independent times within the family Crenuchidae.

Within the *Characidium lauroi* group, when present, the transversal bars vary from eight to 11. The presence of bars varies ontogenetically, with juveniles of *C. japuhybense*, *C. lauroi*, *C. schubarti* and most specimens examined of *C. oiticicai* having bars well marked, but the adults of *C. japuhybense* having bars poorly marked, or completely absent in *C. lauroi*, *C. schubarti* and *C. oiticicai*. Other species of *Characidium* that have faded vertical bars in adults are *C. gomesi*, *C. fasciatum*, *C. mirim*, *C. pellucidum*, *C. satoi* Melo and Oyakawa, 2015, *C. stigmosum*, and *C. xanthopterum* Silveira, Langeani, da Graça, Pavanelli and Buckup, 2008, and the bars can be completely absent as in *C. summus* Zanata & Ohara, 2015 (Eigenmann, 1909; Buckup, 1992; Buckup & Melo, 2002; Silveira *et al.*, 2008; Netto-Ferreira *et al.*, 2013; Melo & Oyakawa, 2015; Zanata & Ohara, 2015).

The small dots on sides of body develop ontogenetically, on the ventral tip of the transversal bars: as the fish grows, the bars fade and the dots become more evident. In *C. travassosi*, the dots are inconspicuous; in *C. japuhybense* the dots are well-marked, circular, and more concentrated in the ventral tip of transversal bars; and in the adults of *C. lauroi*, *C. oiticicai* and *C. schubarti* the dots are well-marked, numerous, and irregularly distributed ventrally and dorsally to the lateral line.

Other species of *Characidium* having marks on body are *C. helmeri*, *C. longum* Taphorn, Montaña and Buckup, 2006, *C. pellucidum* Eigenmann, 1909, *C. pteroides* Eigenmann, 1909, and *C. stigmosum*. *Characidium longum*, *C. pellucidum*, *C. pteroides* are members of Clade C5 (Buckup, 1993b), and restricted to the northern part of South America. The disposition and shape of the spots in those species is different to the species of the *C. lauroi* group: in *Characidium longum* and *C. pellucidum* spots are restricted to the area along the lateral midline and dorsum of body, and *C. pteroides* has distinguishing reddish-brown crescents-shaped marks irregularly distributed on body (Eigenmann, 1912; Taphorn *et al.*, 2006). *Characidium stigmosum* have dots elliptical and much larger when compared to the species of the *C. lauroi* group (Melo & Buckup, 2002). In *Characidium helmeri*, the marks are formed by melanophores more concentrated on the posterior half of scales, forming vertically elongated, narrow spots or dashes (Zanata *et al.*, 2015).

Characidium lauroi group shares the synapomorphies of Clade C1 of Buckup (1993b), which includes the species of *Characidium* with naked isthmus. Seven species were originally included in Clade C1 by Buckup (1993b): *C. boavistae*; *C. bolivianum*; *C. crandellii*; *C. declivirostre*; *C. fasciatum*; *C. gomesi,* and *C. purpuratum*. Later, the following five species were hypothesized as members of clade C1, *C. alipioi*, *C. amaila*, *C. japuhybense*, *C. kamakan*, and *C. timbuiense* (Travassos, 1946, 1955b; Buckup & Reis, 1997; Lujan *et al.*, 2013; Zanata & Camelier, 2015). Five additional species of *Characidium* also have unscaled isthmus and are putative members of Clade C1: *C. grajahuense*, *C. helmeri*, *C. macrolepidotus* Peters, 1868, *C. pterostictum*, and *C. vidali* (Travassos, 1944, 1967; Gomes, 1947; Géry *et al.*, 2001; Zanata *et al.*, 2015).

Within the species of the *C. lauroi* group, the unscaled area of the isthmus is restricted to a smaller area than in the remaining species of Clade C1 (Buckup, 1993b). In *C. travassosi* it is restricted to the isthmus and anterior margin of the cleithrum; in *C. lauroi*, *C. japuhybense* and *C. oiticicai*, it extends to the level of the three anterior pectoral-fin rays, but not surrounding the pectoral fins; and *C. schubarti* has this character variable, with both conditions mentioned above (Travassos, 1949a, 1949b, 1955a, 1967; our data).

Characidium hasemani Steindachner, 1915 and *C. lanei* Travassos, 1967 have naked isthmus, but according to the phylogenetic hypothesis proposed by Buckup (1993b), they fit elsewhere in the phylogeny. Noteworthy, *C. interruptum* Pellegrin, 1909 was referred as having unscaled isthmus (Buckup, 1993b; Melo & Buckup, 2002), but all specimens examined by us have the isthmus completely scaled, suggesting that this character needs to be reevaluated.

The two additional synapomorphies of Clade C1 (Buckup, 1993b) are variable among the species of the *C. lauroi* group. The reduction or absence of postcleithrum 1 (character 23, Buckup, 1993b) is only present in *C. lauroi*, *C. oiticicai* and *C. schubarti*, and the reduction of the fontanel and exclusion of the frontals from its anterior margin (character 8, Buckup, 1993b) is present in *C. oiticicai* and *C. schubarti*. These variations reinforce the need for further phylogenetic studies focused on the species of *Characidium*, with the inclusion of a larger number of species and new characters (Buckup, 1993b; Netto-Ferreira *et al*., 2013; Zanata & Camelier, 2015).

Comparative Material Examined. Material examined in addition to Melo & Oyakawa (2015). All from Brazil: *Characidium lauroi*: MNRJ 5530, 1 (paratype) 56.0 mm SL, Rio de Janeiro, Rezende, rio das Pedras. MNRJ 6118-24, 7, 54.4-43.0 mm SL, MNRJ 13701, 202 (4 cs), 32.7-71.7 mm SL, MNRJ 13703,76, 22.3-33.3 mm SL, MNRJ 14404, 54 (2 cs), 30.1-57.7 mm SL, MNRJ 14408, 4 (1 cs), 47.2-51.9 mm SL, MNRJ 17432, 3, 33.2-37.1 mm SL, MNRJ 21687, 45. 6 mm SL, MCP 19863, 5, 29.0-45.0 mm SL, MCP 19864, 38, 36.0-25.6 mm SL, MZUSP 68800, 10, 27.0-46.9 mm SL, Rio de Janeiro, Teresópolis, rio Paquequer. MNRJ 11688, 1, 50.7 mm SL, MNRJ 17443, 1, 45.4 mm SL, MNRJ 19402, 1, 49.57 mm SL, Rio de Janeiro, Itatiaia, rio Pirapetinga. MNRJ 12843, 13 (2 cs), 47.5-63.6 mm SL, MNRJ 14025, 1, 30.3 mm SL, MNRJ 15036, 2, 59.7-51.5 mm SL, MNRJ 15043, 1, 51.2 mm SL, MNRJ 19316, 3 (1 cs), 70.2-80.7 mm, MNRJ 20052, 3, 27.2-35.7 mm, Rio de Janeiro, Petrópolis, rio Paquequer. MZUSP 104206, 8, 47.8-51.8 mm SL, São Paulo, Pindamonhangaba. MZUSP 49110, 24 (2 cs), 48.4-56.3 mm SL, MZUSP 49119, 4, 33.0-50.3 mm SL, São Paulo Pindamonhangaba, rio Ribeirão Grande. MZUSP 51933, 5, 37.5-53.6 mm SL, São Paulo, Silveira, rio da Bocaina. MZUSP 109819, 41 (1 cs), 32.5-47.4 mm SL, MZUSP 109826, 14 (3 cs), 37.1-60.2 mm SL, São Paulo, Bananal. UFRJ 616, 3 (2 cs), 45.5-49.6 mm SL, Rio de Janeiro, Itatiaia, rio Bonito. UFRJ 35494, 3, 34.5-71.15 mm SL, São Paulo, Monteiro Lobato rio Bujurquinha. *Characidium japuhybense*: MNRJ 5191-5193, 5195-5201, 5205, 5207, 12 (all paratypes in the same jar), 40.4-53.1 mm SL, MNRJ 11693, 21 (1 cs), 27.2-30.3 mm SL, Rio de Janeiro, Angra dos Reis, rio Japuíba. MNRJ 11448, 87, 37.3-44.0 mm SL, MNRJ 11449, 5, 45.3-38.4 mm SL, MNRJ 11450, 5, 39.5-40.4 mm SL, MNRJ 11692, 24, 32.4-52.1 mm SL, Angra dos Reis, Rio de Janeiro, rio Zungú. MNRJ 13787, 47 (2 cs), MNRJ 13789, 35, 23.0-41.5 mm SL, MNRJ 13790, 27, 25.8-44.3 mm SL, MNRJ 13794, 36, 31.3-41.8 mm SL, MNRJ 11444, 38, 25.4-53.4 mm SL, MNRJ 19595, 1, 45.6 mm SL, Rio de Janeiro, Paraty, rio Parati-Mirim. MNRJ 19193, 3, 19.8-22.6 mm SL, Rio de Janeiro, Angra dos Reis, rio Perequê. MNRJ 19595, 1, 54.0 mm SL, Rio de Janeiro, Paraty, rio Forquilha. MNRJ 20596, 1, 19.6 mm SL, MNRJ 20600, 1, 55.4 mm SL, MNRJ 20876, 2, 49.15-50.9 mm SL, Rio de Janeiro, Ilha Grande, Angra dos Reis, rio Andorinha. MZUSP 39994, 2, 24.8-34.5 mm SL, MZUSP 83447, 1, 57.0 mm SL, MZUSP 90376, 41 (1 cs), 35.8-58.6 mm SL, São Paulo, Ubatuba. MZUSP 60251, 5, 54.4-37.7 mm SL, São Paulo, Barra do Turvo, rio Ribeira de Iguape. MZUSP 61770, 4, 51.7-49.9 mm SL, MZUSP 61774, 3, 55.5-49.2 mm SL, MZUSP 61788, 7, 59.4-37.7 mm SL, MZUSP 62014, 2, 60.0-42.2 mm SL, MZUSP 61797, 9 (2 cs), 47.7-23.5 mm SL, MZUSP 62018, 8, 49.4-31.0 mm SL, MZUSP 62036, 3, 61.7-49.1 mm SL, MZUSP 62037, 3, 45.9-34.3 mm SL, São Paulo, Iporanga, rio Ribeira de Iguape. MZUSP 90372, 16, 33.7-51.3 mm SL, São Paulo, Cubatão. MZUSP 107319, 3, 36.2-42.2 mm SL, São Paulo, Ilhabela, São Sebastião. *Characidium schubarti*: MNRJ 8853, 50,3 mm SL (holotype), Paraná, border of Joaquim Murtinhos and Jaguariaíva; MNRJ 8852, 8854-8857, 4 (all paratypes in the same jar), 45.7-56.4 mm SL, collected with holotype. MZUSP 53151, 59, 55.7-22.3 mm SL, MZUSP 53152, 11, 44.0-21.5 mm SL, MZUSP 53142, 11, 54.7-32.8 mm SL, MZUSP 54911, 5, 42.0-39.5 mm SL, MZUSP 62405, 9, 52.6-34.9 mm SL, São Paulo, Apiaí, rio Ribeira de Iguape. MZUSP 51060, 4, 43.26-37.09 mm SL, MZUSP 51874, 7, 46.4-41.3 mm SL, MZUSP 51884, 1, 48.8 mm SL, MZUSP 51891, 2, 44.4-44.0 mm SL, MZUSP 51892, 1, 21.8 mm SL, MZUSP 51904, 5, 49.8-35.3 mm SL, MZUSP 51906, 5, 40.5-26.2 mm SL, MZUSP 52599, 16, 39.1-26.6 mm SL, MZUSP 52585, 1, 26.32 mm SL, São Paulo, Ribeirão Grande, rio Paranapanema basin. MZUSP 55014, 1, 33.4 mm SL, São Paulo, Capão Bonito, rio Paranapanema basin. MNRJ 19306, 3, 45.6-33.3 mm SL, Paraná, Jaguariaíva, rio Paranapanema basin. MNRJ 11454, 74, 40.7-19.0 mm SL, MNRJ 11455, 4, 54.6-18.5 mm SL, São Paulo, Itatinga rio Paranapanema basin. MNRJ 11457, 29, 64.5-39.9 mm SL, MNRJ 11458, 28 (2 cs), 37.2-18.6 mm SL, MNRJ 11462, 1. 46.5 mm SL, MNRJ 11456, 7, 38.9-21.6 mm SL, MNRJ 11686, 1, 45.2 mm SL, MNRJ 19394, 1, 40.3 mm SL, MNRJ 1999, 1, 19.0 mm SL, MNRJ 20244, 4, 32.4-24.4 mm SL, São Paulo, Botucatu, rio Paranapanema basin. *Characidium oiticicai*: MNRJ 20102, 5, 29.6-40.3 mm SL, São Paulo, Biritiba-Mirim, rio Biritiba-Açu drainage. MNRJ 5787, 3, 34.7-46.1 mm SL, USNM 288896, 1, 50.2 mm SL, MZUSP 54912, 8, 62.5-32.4 mm SL, São Paulo, Iporanga, rio Ribeira de Iguape basin. MZUSP 54909, 19, 58.4-28.3 mm SL, MZUSP 54975, 36, 57.8-25.8 mm SL, São Paulo, Apiaí, rio Ribeira de Iguape basin. MZUSP 26870, 13, 31.4-67.2 mm SL, MZUSP 78094, 2, 27.4-60.7 mm SL, MZUSP 86961, 2, 41.1-46.8 mm SL, São Paulo, Salesópolis, rio Claro. USNM 289989, 1, 52.9 mm SL, São Paulo, Santo André, Ribeirão Grande.

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