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## Review of the species of the genus *Serrapinnus* Malabarba, 1998 (Teleostei: Characidae: Cheirodontinae) from the rio Tocantins-Araguaia basin, with description of three new species

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### Abstract

Species of the genus *Serrapinnus* from the rio Tocantins-Araguaia basin are revised and three new species are described. *Serrapinnus aster* new species is diagnosed by the presence of scimitar-shaped ventral procurrent caudal-fin rays of mature males forming a semicircle and by the presence of 7–9 cusps on the premaxillary teeth; *S. lucindai* new species is distinguished from its congeners by the presence of a higher number of ventral procurrent caudal-fin rays (17 to 19); and *S. tocaninensis* new species differs from the remaining species of the genus by the elongation of the unbranched dorsal and pelvic-fin rays into filaments in mature males. *Serrapinnus sterbai* is recognized as broadly distributed in the Tocantins-Araguaia basin and is redescribed based on specimens from across its entire distribution. A key for the cheirodontines occurring in the Atlantic drainages of northeastern Brazil, from the rio Tocantins-Araguaia to the rio Paraguaçu is provided.

**Key words:** Cheirodontini, *Ctenocheirodon*, identification key, sexual dimorphism, taxonomy

### Resumo

As espécies do gênero *Serrapinnus* da bacia dos rios Tocantins-Araguaia são revisadas e três novas espécies são descritas. *Serrapinnus aster* espécie nova é diagnosticada pela presença de raios procorrentes ventrais da nadadeira caudal com o formato de cimitarra nos machos maduros, formando um semicírculo e pela presença de 7 a 9 cúspides nos dentes do pré-maxilar; *Serrapinnus lucindai* espécie nova é diagnosticada de seus congêneres pela presença de maior número de raios procorrentes ventrais na nadadeira caudal (17 a 19); e *S. tocaninensis* difere das demais espécies do gênero pela presença dos raios não ramificados das nadadeiras dorsal e pélvica alongados em um filamento nos machos maduros. *Serrapinnus sterbai* espécie nova é diagnosticada como amplamente distribuída na bacia e redescrita com base em espécimes de toda sua área de distribuição. É fornecida uma chave para os queirodontíneos dos rios do nordeste brasileiro da bacia do rio Tocantins-Araguaia bacia do rio Paraguaçu.

### Introduction

The genus *Serrapinnus* Malabarba was created together with a cladistic definition of the subfamily Cheirodontinae (Malabarba, 1998). In that study, *Serrapinnus* included a putative monophyletic group of cheirodontines previously assigned to other genera of the subfamily, such as *Cheirodon* Girard, *Odontostilbe* Cope and *Holoshesthes* Eigenmann. The species of *Serrapinnus* were found to share the following synapomorphies: the presence of the caudal peduncle conspicuously arched ventrally in mature males, and the main axis of those ventral procurrent caudal-fin rays not supported by the parhypural being perpendicular to the longitudinal axis of the body, whereas

the most anterior elements are anteriorly directed (Malabarba, 1998). Furthermore, all species of *Serrapinnus* have an incomplete lateral line (except *S. heterodon* (Eigenmann)), hypertrophied hook bearing anal-fin rays in mature males commonly resulting in fused ray segments (shared with some genera of the tribe Cheirodontini), and a high number of ventral procurrent caudal fin rays (shared with all the genera of the tribe Cheirodontini).

*Serrapinnus* is the most species-rich and geographically widespread genus of the tribe Cheirodontini, including eleven species that are geographically distributed in most of the Cis-Andean basins of South America. These are *Serrapinnus microdon* (Eigenmann) and *S. micropterus* (Eigenmann) in the rio Amazonas basin, *S. sterbai* Zarske in the rio Araguaia, *S. gracilis* Géry and *S. littoris* Géry in French Guiana, *S. heterodon* and *S. piaba* (Lütken) in the northeastern drainages of Brazil, including the rio São Francisco basin, *S. potiguar* Jerep & Malabarba from the rio Cear-Mirim, northeastern Brazil, and *S. calliurus* (Boulenger), *S. heterodon*, *S. kriegi* (Schindler), *S. microdon* and *S. notomelas* (Eigenmann) in the Paraná-Paraguay-Uruguay river basins. So far, only one species of the genus is known from the rio Tocantins-Araguaia drainage. We herein describe three new species of *Serrapinnus* from this river system.

## Material and methods

Counts and measurements were preferentially taken on the left side of specimens as described by Fink & Weitzman (1974); with the exception of the number of scale series below the lateral line which was counted from the series just below the lateral line to the scale closest to the pelvic-fin insertion. Measurements were made with a caliper of 0.01 mm precision, and presented as percents of standard length (SL), or head length (HL for subunits of the head). The number of supraneurals, procurrent caudal-fin rays, and vertebrae, which includes the four vertebrae of the Weberian apparatus and the terminal half centrum (Weitzman & Malabarba, 1999), were counted in cleared and stained (c&s) specimens, prepared according to the Taylor & Van Dyke (1985) protocol. In the descriptions, counts are followed by their frequencies in parentheses, and an asterisk indicates the value for the holotype. Scanning Electron Micrographs (SEM) were taken of the mandibular apparatus. Pictures of the caudal and anal fins were taken with a camera connected to a microscope. Bone nomenclature follows Weitzman (1962) and Zanata & Vari (2005).

Specimens from the following institutions were examined in this study: CAS—California Academy of Sciences, San Francisco, USA; FMNH—Field Museum of natural History, Chicago, USA; INPA—Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil; MCP—Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; MZUSP—Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil; UNT—Universidade Federal do Tocantins, Porto Nacional, Brazil; UFRGS—Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; UFRJ—Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; USNM—National Museum of Natural History, Smithsonian Institution, Washington D.C., USA. Measured and counted specimens are indicated between parenthesis in the list of paratypes or analyzed material.

## Results

### *Serrapinnus aster* Malabarba & Jerep, new species

Figs. 1, 2a–b, 3, 4a, 5a

**Holotype.** MZUSP 115011, 22.9 mm SL, male, Brazil, Tocantins State, Município de Arraias, periodic lake at confluence of rio Paraná and rio Bezerra, rio Tocantins drainage, 11 Jan 1989, J. C. Oliveira & W. Costa.

**Paratypes.** All from Brazil, rio Tocantins-Araguaia basin. **Goiás State:** MCP 41862, (3, 31.6–33.2 mm SL), córrego Volta Grande, tributary of left margin of PCH Piranhas reservoir, Município de Piranhas, 16°35'59"S 51°48'33"W, 18 Jul 2007, Equipe CPA Ltda. MCP 42033, (3, 28.4–32.7 mm SL), córrego Salobrinha, tributary of rio Claro, Município de Montes Claros de Goiás, 15°58'35"S 51°24'09"W, 27 Feb 2007, G. A. Pereira. UFRGS 12015, 22, 23.0–31.1 mm SL, Município de Piranhas, tributary of rio Piranhas, between Piranhas and Bom Jardim de Goiás, 16°21'43.3"S 51°55'10.2"W, 7 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. UFRGS 12023,

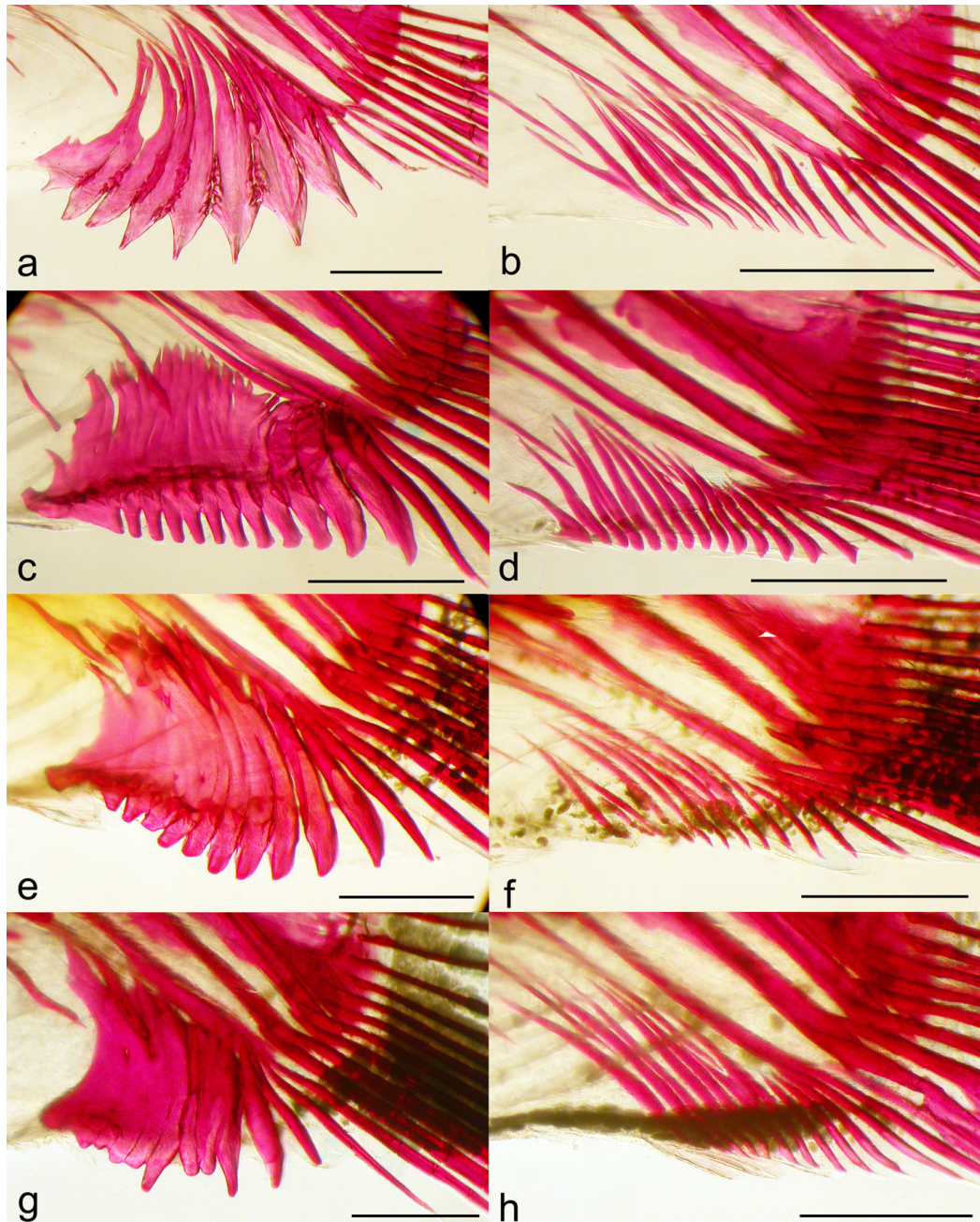
54, 32.3–10.6 mm SL, 2 c&s, 25.3–26.1 mm SL, Município de Montes Claros de Goiás, tributary of rio Claro, 100 km from road intersection to Betânia, between Jussara and Montes Claros de Goiás, 15°55'32.0"S 51°19'25.8"W, 6 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. UFRGS 12034, 5, 28.5–31.0 mm SL, Município de Jussara, tributary of rio Claro, 15°58'0.0"S 50°48'59.7"W, 6 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. **Tocantins State:** MZUSP 115012, 10, 21.3–26.3 mm SL, 2 c&s, 23.9–25.0 mm SL, same data as holotype.



**FIGURE 1.** *Serrapinnus aster*, (a) holotype, male, MZUSP 115011, 22.9 mm SL; Município de Arraias, periodic lake at confluence of rio Paraná and rio Bezerra, Tocantins drainage, Tocantins State, Brazil; (b) paratype, female, MZUSP 115012, 23.6 mm SL, same data as holotype.

**Diagnosis.** *Serrapinnus aster* is distinguished from all congeners except *S. potiguar*, by the scimitar-shaped ventral procurrent caudal-fin rays of mature males, almost all of which form a semicircle, resulting in a portion of the ventral procurrent caudal-fin rays having a multi-pointed partial star-shaped margin (Fig. 2a) vs. ventral procurrent caudal-fin rays rod-shaped or spatulate, usually parallel to each other, except for the anteriormost procurrent rays being inclined forward in some species. Furthermore *S. aster* can be diagnosed from *S. potiguar* and other species of the genus by the presence of 7–9 cusps on the premaxillary teeth (vs. 5 cusps in *S. microdon* and *S. potiguar*, 9 to 11 in *S. lucindai*, *S. sterbai* and *S. tocantinensis* and 10 to 12 in *S. gracilis* and *S. littoris*), the incomplete lateral line (vs. complete in *S. heterodon*), the hyaline dorsal fin (vs. with a proximal black blotch in *S. notomelas*), and the absence of a black spot on the posteroventral region of the abdomen (vs. the presence of a black spot in that region in *S. kriegi*).

**Description.** Morphometric data in Table 1. Body short and compressed. Greatest body depth at dorsal-fin origin. Snout slightly pointed in profile. Dorsal profile of head gently convex from snout to anterior portion of supraoccipital bone. Posterior portion of supraoccipital slightly concave. Predorsal profile slightly convex from posterior end of supraoccipital to dorsal-fin origin. Dorsal-fin origin located at midbody. Dorsal profile from base of last dorsal-fin ray to caudal-fin origin straight to slightly convex in females and ventrally arched in preserved mature males. Ventral profile of caudal peduncle straight in females, distinctly convex due to hypertrophy of ventral procurrent caudal-fin rays in males. Caudal peduncle slightly longer than deep. Ventral profile of head and body from tip of mouth to pelvic-fin origin convex, then straight until anal-fin origin on females but slightly concave in mature males. Anal-fin base straight to slightly concave in females, anteriorly convex and distinctively concave posteriorly in mature males.

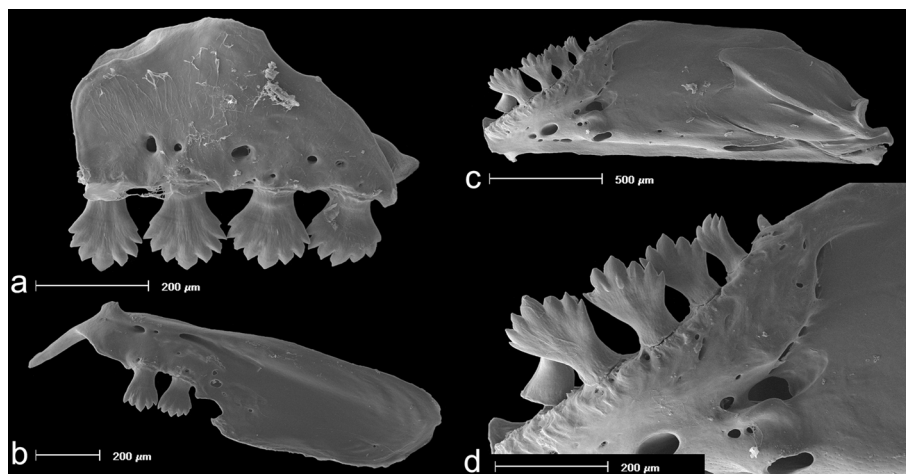


**FIGURE 2.** Ventral procurent caudal-fin rays of species of *Serrapinnus* from the rio Tocantins-Araguaia basin. (a) *Serrapinnus aster*, male, UFRGS 12023, 26.9 mm SL; (b) *S. aster*, female, UFRGS 12023, 35.7 mm SL; (c) *S. lucindai*, male, UFRJ 1260, 24.9 mm SL; (d) *S. lucindai*, female, UFRJ 1260, 25.9 mm SL; (e) *S. sterbai*, male, UFRGS 16447, 28.7 mm SL; (f) *S. sterbai*, female, UFRGS 16447, 29.6 mm SL; (g) *S. tocantinensis*, male, MCP 40417, 31.6 mm SL; (h) *S. tocantinensis*, female, MCP 40417, 33.4 mm SL. Lateral view, anterior to left. Scale bar = 1 mm.

Head relatively small. Posterior margin of opercle sinusoidal with upper portion concave and lower portion convex. Mouth terminal, mouth slit situated immediately below horizontal through middle of pupil. Maxilla angled posteroventrally; posterior tip reaching vertical close to anterior border of eye and horizontal through ventral border of eye. All teeth pedunculated, distally expanded. Premaxilla with 4(1) or 5(1) teeth in single row and bearing 7–9 cusps. Midcentral cusp higher and wider than lateral cusps. Maxilla with 2(2) teeth bearing 5–7 cusps. Dentary with 7(2) large teeth bearing 5 or 7 cusps, followed by one smaller tooth with 3 cusps and one conical tooth. Smaller lateral cusps of dentary teeth sometimes overlapping adjacent tooth cusps; overlap usually absent between posteriormost teeth. All dentary tooth cusps upwardly pointed or slightly directed towards interior of mouth (Fig. 3).

**TABLE 1.** Morphometric data for *Serrapinnus aster*. SD = Standard deviation. Male range includes holotype.

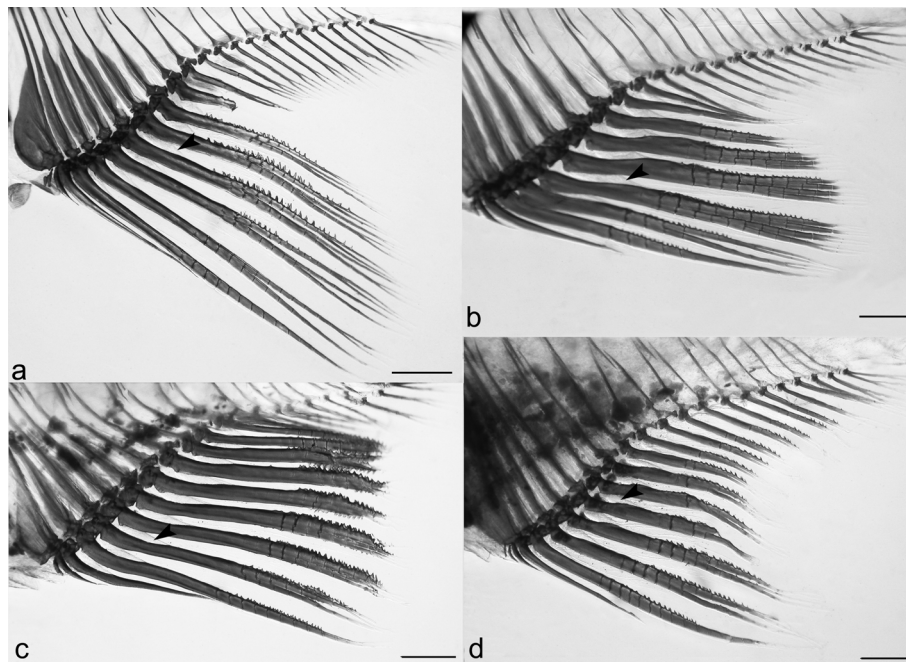
	Holotype	Males	Min	Max	Mean	SD	Females	Min	Max	Mean	SD
Standard length (mm)	22.9	8	22.1	31.7	25.6	3.6	9	21.3	33.2	26.2	4.9
Percent of standard length											
Head length	27.2	8	25.2	28.6	26.7	1.2	9	23.6	28.3	26.1	1.4
Bony head length	26.3	8	23.3	27.8	26.0	1.5	9	23.4	27.1	25.6	1.1
Snout-anal fin distance	69.6	8	61.6	69.6	65.9	3.1	9	61.8	70.5	66.6	2.7
Snout-dorsal fin distance	51.9	8	50.8	53.7	52.3	0.9	9	50.0	54.5	52.0	1.2
Snout-pelvic fin distance	45.9	8	42.2	47.6	45.2	2.2	9	43.3	51.1	48.1	3.1
Snout-pectoral fin distance	27.6	8	24.9	29.4	27.2	1.7	9	25.0	29.5	27.4	1.8
Dorsal-fin base length	13.9	8	12.9	14.4	13.8	0.6	9	12.2	15.1	14.1	0.9
Anal-fin base length	-	3	22.5	24.3	23.4	0.9	9	21.7	26.9	23.5	1.7
Length of caudal peduncle	-	3	19.3	20.9	20.4	0.9	9	16.2	17.4	16.9	0.4
Depth of caudal peduncle	-	3	13.2	16.2	14.7	1.5	9	11.1	13.1	12.1	0.7
Body depth at dorsal-fin	36.8	8	32.8	37.0	34.8	1.7	9	33.0	39.8	38.0	2.2
Dorsal-fin length	32.5	8	28.3	34.9	32.4	1.9	9	27.0	32.8	30.2	2.1
Pelvic-fin length	20.1	8	18.1	21.1	19.7	0.9	9	16.4	18.7	17.7	0.8
Pectoral-fin length	22.6	8	19.3	23.8	21.6	1.4	9	17.6	21.6	20.2	1.2
Percent of head length											
Snout length	23.7	8	23.3	26.4	24.3	1.0	9	22.7	26.3	24.3	1.2
Upper Jaw length	25.8	8	23.2	28.2	25.7	1.8	9	21.8	32.5	25.2	3.0
Horizontal orbit diameter	35.7	8	35.7	42.2	38.0	2.2	9	37.6	40.9	38.9	1.1
Interorbital width	31.4	8	30.7	33.1	31.8	0.9	9	28.8	35.5	32.0	2.5



**FIGURE 3.** *Serrapinnus aster*, MZUSP 115012, 25.2 mm SL; Scanning Electron Microscopy images showing (a) left side premaxilla; (b) maxilla; (c) dentary, and (d) detail of dentary teeth.

Dorsal-fin rays ii,8(1), 9\*(16). Dorsal-fin origin at midlength of body. First unbranched dorsal-fin ray about one-half length of second unbranched ray; following branched rays progressively decreasing in size. Adipose-fin origin slightly posterior to vertical through end of anal-fin base. Anal-fin rays iii,16(2), 17\*(6), 18(7) or 19(2). First unbranched anal-fin ray only observable in cleared and stained specimens. Distal profile of anal-fin slightly concave in females, deeply concave in males. Last unbranched and first 5–6 branched anal-fin rays longer, remaining rays progressively decreasing in size. Tip of longest anal-fin rays of mature males laterally overlapping last anal-fin rays, and sometimes reaching ventral procurrent caudal-fin rays when caudal peduncle arched. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Males with acute, elongate, retrorse hooks,

posterolaterally arranged on last unbranched to 8<sup>th</sup>, 9<sup>th</sup> or 10<sup>th</sup> branched anal-fin rays (Fig. 4a). Two unpaired hooks present per lepidotrichia ray segment of on each lateral half of ray. Hooks situated along posterior margin and posterior branches of rays; extending from distal half of proximal lepidotrichia segment to distal end of ray. Hook-bearing rays with segments and branches progressively fused with increasing maturation of males. Mature males with hypertrophied soft tissue associated with hook-bearing anal-fin rays. Pectoral-fin rays i,9\*(6), 10(9), 11(2). Pectoral-fin ray falling short of pelvic-fin origin in females, but extending beyond that point in males. Pelvic-fin rays i,7\*. Pelvic-fin origin anterior to vertical through dorsal-fin origin. Pelvic-fin rays of males with 1 or 2 acute, elongate hooks per lepidotrichia segment. Hooks ventromedially placed on all rays, and associated with hypertrophied soft tissue. Principal caudal-fin rays 18(1), 19\*(14). Procurent caudal-fin rays 11(2) dorsal, 13(2) ventral. Ventral procurent caudal-fin rays hypertrophied in mature males, extending beyond ventral muscles and skin of caudal-peduncle resulting in multi-pointed semicircular star-shaped structure. Hypertrophied ventral procurent ray scimitar-shaped: anteriorly bent, proximally acute, expanding distally and ending abruptly in pointed distal tip (Fig. 2a).



**FIGURE 4.** Anal fin of mature males of the species of *Serrapinnus* from rio Tocantins-Araguaia basin showing hypertrophied anal-fin rays and hooks shape and distribution. (a) *Serrapinnus aster*, male, UFRGS 12023, 26.9 mm SL; (b) *S. lucindai*, male, UFRJ 1260, 24.9 mm SL; (c) *S. sterbai*, male, UFRGS 16447, 29.7 mm SL; (d) *S. tocantinensis*, male, MCP 40417, 31.6 mm SL. Lateral view, anterior to left. Arrow head pointing to ligaments connecting approximately midlength of posterior face of proximal segment of lepidotrichia to proximal anterior face of lepidotrichia of the subsequent ray. Scale bar = 1 mm.

Scales cycloid, similar in size over all of body. Lateral line partially pored with 6\*(2), 8(5), 9(8), 11(1), 13(1) pored scales; scales in lateral line scale row 31(3), 32\*(6), 33(4), 34(3), 35(1). Predorsal scales 9(7), 10(6), 11(2), 12(1). Scale rows between lateral line and dorsal-fin origin 5(1) or 6\*(16). Scale rows between lateral line row and pelvic-fin origin 4\*(16) or 5(1). Scale rows around caudal peduncle 12(1), 13\*(8), 14(8). Scales along anal-fin base 6(1), 8\*(2), 9(3), 10(6), 11(3), 12(1), 13(1).

Supraneurals 4 or 5; abdominal vertebrae 15; caudal vertebrae 19 in two clear and stained specimens.

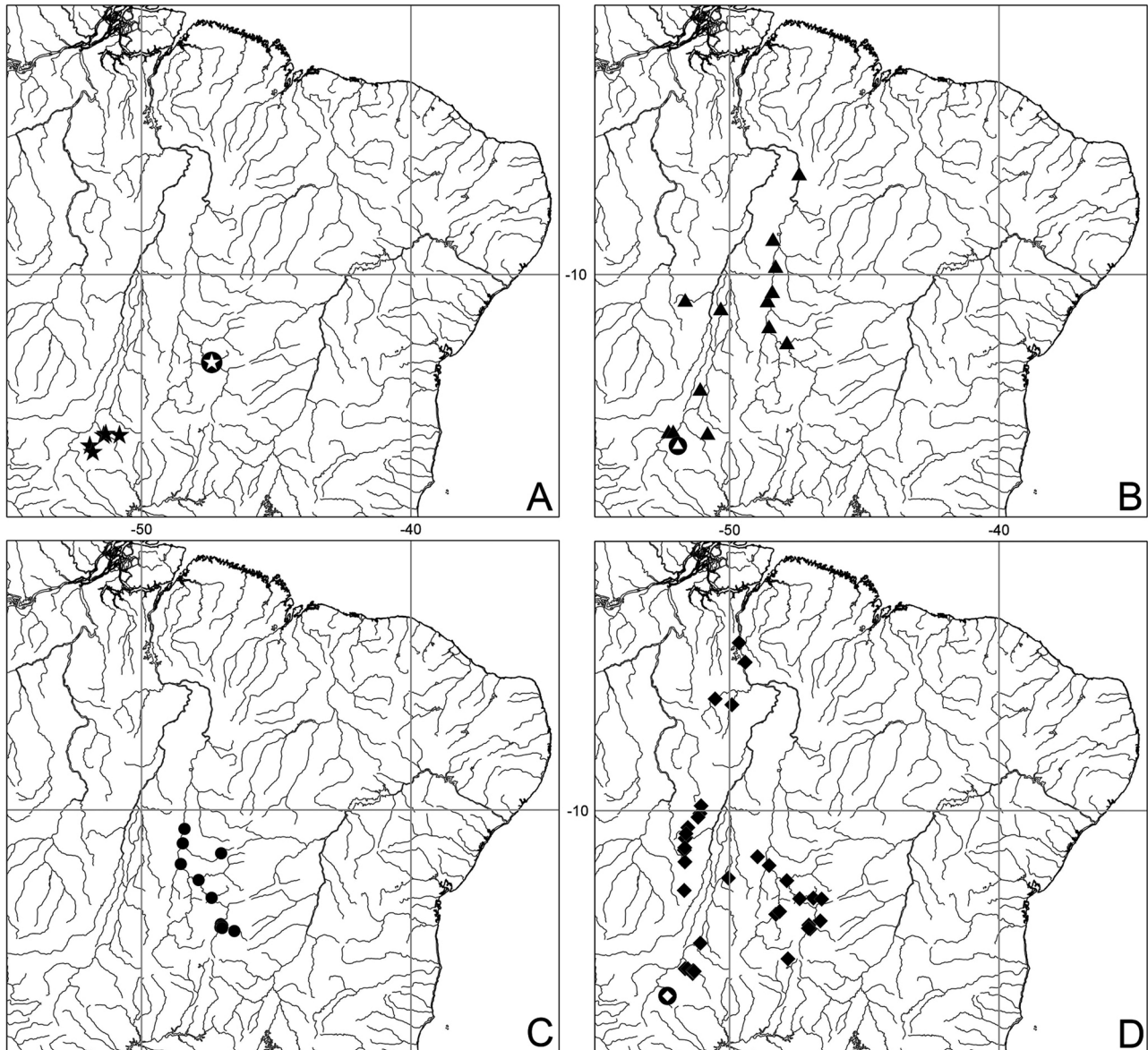
**Color in alcohol.** Overall background body color yellow (Fig. 1). Head with numerous and large melanophores on dorsal and opercular regions. Small, dark melanophores surrounding mouth opening and over maxilla. Scales on dorsum and on rows above lateral line with subtle reticulated color pattern due to concentration of melanophores along distal border of scales. Body with faint dark midlateral stripe, usually in form of narrow black line along middle longitudinal body axis, beginning anterior to dorsal-fin origin and ending in caudal spot. Body with scattered pigmentation ventral of lateral line. Melanophores aligned along myosepta on posteroventral region of body. Black to brown, rounded spot on caudal-fin base; spot not reaching upper or lower margin of caudal peduncle and extending posteriorly over one-half to two-thirds of middle caudal-fin rays. Dorsal, anal, pectoral and

pelvic fins scattered with few melanophores between rays. Adipose fin unpigmented. Caudal fin covered with diffuse dark chromatophores along fin rays, except for clear areas on base of caudal-fin lobes just posterior of caudal-fin spot. No humeral spot; triangular, darkened area in humeral region due to presence of pseudotympanum within musculature.

**Sexual dimorphism.** Sexually mature males with hooks on pelvic- and anal-fin rays, ventrally arched caudal peduncle in preserved specimens; hypertrophied hook bearing anal-fin rays, expanded in sagittal plane usually with fused ray segments; and hypertrophied ventral procurrent caudal-fin rays (Figs. 1, 2a–b, 4a).

**Distribution.** *Serrapinnus aster* is distributed on the upper portions of the rio Tocantins basin, mainly in the tributaries of the rio Paraná and rio Tocantins (Fig. 5a).

**Etymology.** The species name, *aster*, refers to the star-shaped ventral profile of the set of hypertrophied procurrent caudal-fin rays present in the mature males of the species.



**FIGURE 5.** Geographic distribution of the species (a) *Serrapinnus aster* (black stars; white star in black dot = type locality), (b) *S. lucindai* (black triangles; white triangle in black dot = type locality), (c) *S. sterbai* (black dots) and (d) *S. tocantinensis* (black lozenges; white lozenge in black dot = type locality) in rio Tocantins-Araguaia basins. Some symbols represent more than one locality.

***Serrapinnus lucindai* Jerep & Malabarba n. sp.**

Figs. 2c–d, 4b, 5b, 6, 7

**Holotype.** UFRGS 19198, 21.1 mm SL, Município de Piranhas, tributary of rio Piranhas, between Piranhas and Bom Jardim de Goiás, 16°21'43.3"S 51°55'10.2972"W, 7 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep.

**Paratypes.** All from Brazil, rio Tocantins-Araguaia basin. **Goiás State:** UFRGS 12029, 14, 14.7–29.6 mm SL, Município de Aragarças, córrego Capivara, between Aragarças and Jussara, 15°54'34.5"S 52°5'34.6"W, 5 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. UFRGS 16444, 7, 22.5–26.3 mm SL, Município de Jussara, tributary of rio Claro, 15°58'0.0"S 50°48'59.7"W, 6 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. UFRGS 16445, 35, 15.3–25.2 mm SL, collected with holotype. **Tocantins State:** UFRJ 2128, (3, 19.6–22.8 mm SL), Ilha do Bananal, Fazenda Canguçu, margin of rio Javares, 17 Feb 1994, W. Costa, G. Brasil & C. Campinha. UNT 4135, 3, 18.3–22.5 mm SL, Município de Brejinho de Nazar, córrego Sussuarana, 15 Feb 2002, NEAMB-UFT. UNT 4136, 2, 21.3–21.4 mm SL, Município de Guara, córrego Barreiro, 20 Oct 2000, NEAMB-UFT. UNT 4137, 1, 20.0 mm SL, Município de Lageado, rio Tocantins, close to UHE Lageado, rio Tocantins bottleneck, 27 Jan 2000, NEAMB-UFT. UNT 4745, 1, 25.3 mm SL, Município de Paraná, córrego Lageado, 7 Aug 2000, NEAMB-UFT. UNT 4759, 5, 16.1–19.7 mm SL, Município de Peixe, Fazenda Água Branca, lagoa Dionísio, 11 Sep 2001, NEAMB-UFT. UNT 6630, 4, 17.7–18.9 mm SL, Município de Tocantinópolis, córrego Santana, 29 Jun 2000, NEAMB-UFT. UNT 6927, 1, 21.7 mm SL, Município de Porto Nacional, rio Tocantins, 8 Oct 2002, NEAMB-UFT. UNT 7328, (1, 25.6 mm SL), Município de Porto Nacional, Fazenda Don Augusto, rio das Éguas, 19 Sep 2002, NEAMB-UFT. **Mato Grosso State:** MCP 40302, 44, 10.7–27.9 mm SL, Município de Porto Alegre do Norte, rio Xavantino 16 km south of Porto Alegre do Norte in highway BR 158, 11°01'30"S 51°38'47"W, 27 Oct 2005, J. P. Silva. UFRGS 12020, 7, 23.5–24.7 mm SL, Mato Grosso, Município de Pontal do Araguaia, stream tributary of rio das Garças, 15°54'27.9"S 52°15'51"W, 8 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. UFRJ 1260, 58, 15.9–34.5 mm SL, (22, 22.1–34.5 mm SL, 4c&s 24.8–25.4 mm SL), creek 13 km west of rio das Mortes, left margin, between Água Boa and Cocalinho, 20 Feb 1993, W. Costa, C. Bore, R. Cunha & C. Muratori.

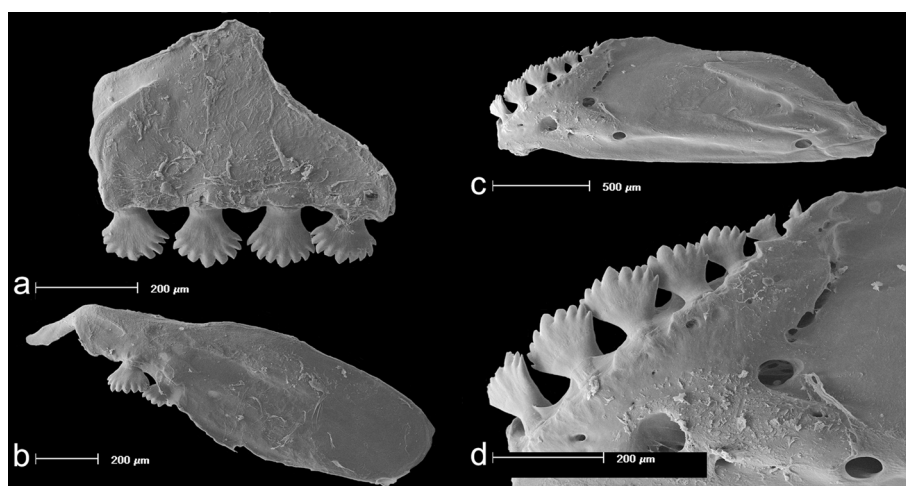


**FIGURE 6.** *Serrapinnus lucindai* (a) holotype, male, UFRGS 19198, 21.1 mm, córrego Fundo, tributary of rio das Garças, Município de Barra do Garças, Mato Grosso, Brazil; (b) paratype, female, UFRGS 16445, 20.1 mm SL, same data as holotype.



**Diagnosis.** *Serrapinnus lucindai* is primarily distinguished from its congeners by the 17 to 19 ventral procurrent caudal-fin rays (*vs.* less than 17). Furthermore, the species can also be diagnosed from the remaining species of the genus by the presence of anal-fin hooks on the first unbranched and five branched rays of mature males (*vs.* anal-fin hooks on at least the anterior six branched rays on the remaining species of the genus), the absence of a continuous mid-lateral black stripe extending from the opercular region to the caudal-peduncle spot (*vs.* presence of a stripe in *S. sterbai*), the presence of 9 to 11 cusps on the premaxillary teeth (*vs.* 5 in *S. microdon* and *S. potiguar*, 7 in *S. aster*, 7 to 9 in *S. calliurus*, *S. heterodon*, *S. kriegi*, *S. micropterus*, *S. notomelas* and *S. piaba*, and 10 to 12 in *S. gracilis* and *S. littoris*), the dentary teeth without expanded cusps forming a sharp cutting edge and the incomplete lateral line (*vs.* dentary teeth with expanded cusps forming a sharp cutting edge and complete lateral line in *S. heterodon*), the hyaline dorsal fin (*vs.* fin with a proximal black blotch in *S. notomelas*), and an absence of a black spot in the posteroventral region of the abdomen (*vs.* the presence of a black spot in that region in *S. kriegi*).

**Description.** Morphometric data in Table 2. Body elongated and compressed. Greatest body depth at dorsal-fin origin. Dorsal profile of head strongly convex from tip of snout to vertical through anterior margin of anterior nares; gently convex from that point to base of supraoccipital process, then straight to slightly concave along length of supraoccipital process. Predorsal profile convex. Profile straight to slightly convex along dorsal-fin base. Dorsal profile from last dorsal-fin ray insertion to adipose fin slightly convex in immatures and females, deeply convex in adult males with ventrally arched caudal peduncle. Dorsal profile straight to slightly concave from end of adipose-fin base to anteriormost dorsal procurrent caudal-fin ray. Ventral profile of head convex along anterior region of lower jaw, gently convex from that point to pelvic-fin insertion. Ventral region straight to slightly concave from pelvic-fin insertion to anal-fin origin in immatures and females, deeply concave in mature males. Anal-fin base slightly concave in immatures and females; conspicuously convex in mature males along anterior region supporting hypertrophied anal-fin rays and then straight posteriorly. Ventral profile of caudal-peduncle slightly concave in immatures and females, convex in mature males due to hypertrophied procurrent caudal-fin rays extending ventrally through muscle and skin. Caudal peduncle slightly longer than deep; ventrally arched in alcohol preserved mature males. Posterior margin of opercle sinusoidal with upper portion concave and lower portion convex. Mouth terminal; mouth slit on horizontal through middle of pupil. Maxilla angled posteroventrally; posterior tip falling short of vertical through anterior border of eye and horizontal through ventral border of eye. All teeth multicuspidate, pedunculate, compressed and distally expanded (Fig. 7). Premaxillary teeth 4(4), with 9 to 11 cusps; central cusp slightly longer and wider than lateral cusps. Two (3) or 3(1) maxillary teeth with 5 to 11 cusps. Large dentary teeth 4(2) or 5(2) with 7 to 9 cusps, followed by one (4) tooth with 5 cusps, and 1 to 3 smaller teeth with 1 to 3 cusps. Small lateral cusp of dentary teeth overlapping adjacent tooth cusps, other than on posterior teeth. All dentary tooth cusps pointed upward or slightly recurved towards interior of mouth.



**FIGURE 7.** *Serrapinnus lucindai*, UFRJ 1260, 25.1 mm SL; Scanning Electron Microscopy images showing (a) left side premaxilla; (b) maxilla; (c) dentary, and (d) detail of the dentary teeth.

**TABLE 2.** Morphometric data for *Serrapinnus lucindai*. SD = Standard deviation. Male range includes holotype.

	Holotype	Males	Min	Max	Mean	SD	Females	Min	Max	Mean	SD
Standard length (mm)	21.9	16	21.9	31.6	25.1	2.2	15	19.7	34.5	27.0	3.4
Percent of standard length											
Head length	27.0	16	24.6	28.3	26.6	0.9	15	24.1	27.3	25.6	0.8
Bony head length	26.5	16	24.4	27.2	25.7	0.8	15	23.0	26.3	24.3	1.0
Snout-anal fin distance	63.6	16	61.7	67.0	64.4	1.4	15	63.4	70.1	67.2	1.8
Snout-dorsal fin distance	50.6	16	50.6	53.8	52.3	1.0	15	50.3	54.5	52.8	1.1
Snout-pelvic fin distance	44.4	16	44.2	48.7	46.6	1.0	15	44.3	50.5	47.1	1.7
Snout-pectoral fin distance	27.5	16	25.2	28.6	26.8	0.9	15	24.3	27.3	25.9	0.9
Dorsal-fin base length	12.8	16	12.7	14.3	13.6	0.5	15	11.8	13.1	12.4	0.4
Anal-fin base length	23.8	16	22.2	28.9	24.6	1.9	15	20.9	25.9	23.2	1.3
Length of caudal peduncle	16.5	16	14.1	17.1	15.8	0.9	15	12.8	17.7	15.0	1.2
Depth of caudal peduncle	12.8	16	11.8	14.2	13.2	0.7	15	10.4	13.1	11.9	0.8
Body depth at dorsal-fin	33.9	16	28.0	36.4	30.3	2.0	15	27.5	35.9	32.1	2.4
Dorsal-fin length	27.9	16	27.9	31.7	29.0	1.0	15	25.1	29.3	27.4	1.2
Pelvic-fin length	16.5	16	16.3	19.2	17.7	0.9	15	15.3	18.2	16.7	0.9
Pectoral-fin length	21.5	16	19.2	22.7	21.2	1.2	15	18.0	20.4	19.0	0.7
Percent of head length											
Snout length	23.1	16	22.9	29.1	26.1	1.9	15	22.7	26.6	25.0	1.2
Upper Jaw length	25.8	16	23.5	27.8	25.7	1.2	15	24.0	28.1	25.7	1.4
Horizontal orbit diameter	37.9	16	34.4	41.7	37.9	1.9	15	32.9	41.5	36.4	2.3
Interorbital width	29.3	16	24.8	33.3	29.4	1.9	15	26.5	34.2	30.1	1.8

Dorsal-fin rays ii,9\*(31). Dorsal-fin origin slightly anterior to vertical through midlength of SL. First unbranched dorsal-fin ray about half length of second unbranched dorsal-fin ray. Second unbranched dorsal-fin ray longest in fin; branched rays slightly decreasing in size posteriorly. Adipose-fin origin on vertical through base of last anal-fin ray in females and posterior to that point in males. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Anal-fin rays iii\*-iv,17\*(2), 18(9), 19(13), 20(5) or 21(2). Distal border of anal-fin concave; last unbranched and anterior 5–8 branched rays longer than posterior rays. Tip of longest ray of depressed anal-fin of mature males falling short vertical through base of last anal-fin ray. Males with acute, elongate, retrorse hooks on distal half of anal-fin rays. Hooks posterolaterally arranged on last unbranched to 4<sup>th</sup> or 5<sup>th</sup>, rarely 7<sup>th</sup>\*(2) branched rays (Fig. 4b). Two or three unpaired hooks per ray segment of each contralateral lepidotrichia. Hooks generally located on posterior margin of posterior branches of anal-fin rays. Hook bearing anal-fin ray segments and branches progressively fused in course of maturation of males. Mature males with hypertrophied soft whitish tissue on interradial membrane anterior to anal-fin hooks. Pectoral-fin rays i,9\*(19) or 10(12). Tip of pectoral fin falling short of pelvic-fin origin in immatures and females, but extending beyond that point in mature males. Pelvic-fin rays i,6(3) or 7\*(28). Pelvic-fin origin slightly anterior to dorsal-fin origin. Longest pelvic-fin ray falling short of anal-fin origin in immatures and females, but extending beyond that point in adult males. Males with one or two acute elongate and ventral-medially placed hooks per segment of lepidotrichia on branched pelvic-fin rays. One specimen with hook on unbranched pelvic-fin ray. Adult males with hypertrophied soft whitish tissue anterior to hooks on ventral surface of pelvic-fin. Principal caudal-fin rays 18(1), 19\*(29) or 20(1). Procurrent caudal-fin rays: dorsal 12(1), 13(1), 14(1) or 15(1); ventral 17(1), 18(2) or 19(1). Adult males with ventral procurrent caudal-fin rays hypertrophied, typically fused to each other and distal tips extending through ventral muscles and skin of caudal-peduncle (Figs. 2c, 6). Hypertrophied ventral procurrent caudal-fin rays elongated, rod-shaped, straight, proximally acute and round to flat distally.

Scales cycloid; similar in size over all of body. Lateral line partially pored with 8\*(13), 9(13) or 10(5) pored scales and 31(6), 32\*(12), 33(7) or 34(6) in lateral-line scale series. Predorsal series in regular row 10(3), 11\*(21)

or 12(7). Scale rows between lateral line and dorsal-fin origin 5\*(27) or 6(4). Scale rows between lateral line and pelvic-fin origin 4\*(28) or 5(3). Scale rows around caudal peduncle 12(5), 13(11) or 14\*(15). Axillary scale on pelvic-fin base extending posteriorly for one or two scales. Scales along anal-fin base 9(1), 10(3), 11(15), 12(7), 13(3) or 14(1).

Counts based on four clear and stained specimens: Supraneurals 4(4); abdominal vertebrae 15(2) or 16(2); caudal vertebrae 17(2) or 18(2).

**Color in alcohol.** Overall ground coloration of body pale yellow; darker dorsally from head to end of caudal peduncle. Body with faint dark, rarely silver, midlateral stripe. Longitudinal stripe extending from region slightly anterior to vertical through dorsal-fin origin to light pigmented area preceding caudal spot. Scale series above longitudinal line with higher concentration of darker chromatophores. Abdominal region ventral to longitudinal line lighter. Caudal spot rounded and black, preceded by lightly pigmented area and situated over posterior portion of caudal peduncle and base of central portion of caudal fin, not reaching dorsal or ventral margins of caudal peduncle. Fins mostly hyaline with scattered, sparse dark chromatophores. Dorsal fin with higher concentration of dark chromatophores along unbranched and first branched rays. Adipose fin with few sparse dark chromatophores. Caudal fin with dark chromatophores along fin rays, except for clear areas at base of each caudal-fin lobe. Humeral region with triangular, dark area resulting from pseudotympanum within musculature (Fig. 6).

**Sexual dimorphism.** Mature males of *S. lucindai* have caudal peduncle ventrally arched, as in other species of *Serrapinnus*. Males also have hooks on the pelvic and anal-fin rays. The hook bearing anal-fin rays are hypertrophied, expanded in the sagittal plane, and commonly have the ray segments fused. The ventral procurent caudal-fin rays of mature males are hypertrophied and extend ventrally beyond caudal peduncle muscle and skin (Figs. 2c–d, 4b, 6).

**Distribution.** *Serrapinnus lucindai* is distributed in several tributaries of the rio Tocantins-Araguaia basin (Fig. 5b).

**Etymology.** The species name *lucindai* is in honor to the Brazilian ichthyologist Paulo Henrique Franco Lucinda (UNT), in recognition of his contribution to the taxonomy of Neotropical freshwater fish, mainly those of the rio Tocantins basin.

### ***Serrapinnus sterbai* Zarske, 2012**

Figs. 2e–f, 4c, 5c, 8, 9

*Serrapinnus sterbai* Zarske, 2012: 4 (original description; type locality: Araguaya [misspelled locality name Araguaia] - Gebiet, Ostbrasilien(?), Import Firma Glaser, Holotype: UFRJ 8516, 34.1 mm SL [fig. 1 of an alcohol preserved specimen labeled as the holotype is actually one paratype, male, from MTD F 32658-32664; figs. 3 and 4 of a radiographed specimen and a live specimen in aquarium correspond to the holotype UFRJ 8516. See Remarks below]).

**Diagnosis.** *Serrapinnus sterbai* is distinguished from all congeners by the presence of a wide, black, lateral stripe extending from the region of the supracleithrum to the dark spot on the caudal peduncle (Fig. 8).

**Description.** Morphometric data in Table 3. Body short and compressed. Greatest body depth at dorsal-fin origin. Snout slightly rounded to pointed. Dorsal profile of head gently convex from tip of snout to vertical through anterior nares, slightly convex from that point to anterior portion of supraoccipital bone, with posterior region of supraoccipital spine slightly concave. Predorsal profile slightly convex between tip of supraoccipital spine and dorsal-fin origin, slightly convex to straight along dorsal-fin base, straight to slightly convex from last dorsal-fin ray insertion to caudal-fin origin, but ventrally arched in mature males. Ventral profile convex from mouth opening to isthmus, convex from that point to pelvic-fin origin, then straight until vertical through anal-fin origin in immatures and females and slightly concave in mature males. Anal-fin base straight to slightly concave in immatures and females, but distinctively convex along anterior portion and ventrally arched along posterior portion in mature males. Caudal peduncle slightly longer than deep. Dorsal and ventral profiles of caudal-peduncle straight to lightly concave in immatures and females, but dorsal profile ventrally arched and ventral profile distinctly convex due to ventral procurent caudal-fin rays hypertrophy in mature males (Fig. 2e, 8). Head relatively small. Posterior margin of opercle sinusoidal with upper portion concave and lower portion convex. Mouth terminal, mouth slit just above horizontal through middle of pupil. Maxilla angled posteroventrally, posterior tip reaching vertical close to anterior border of orbit and horizontal through ventral border of orbit. All teeth pedunculated,

distally expanded and similar in shape (Fig. 9). Premaxillary teeth 4(2) or 5(2) with 9 or 11 cusps, lateralmost tooth rarely with 5 cusps; central cusp longer and wider than other cusps. Two (4) maxillary teeth with 7 cusps; a third conical tooth in one specimen. Large anterior dentary teeth 5(3) or 6(1) with 7 cusps; these followed by 1(2) or 2(2) teeth with 3 or 5 cusps. Smaller cusps of dentary teeth overlapping adjacent tooth cusps. All dentary tooth cusps pointed dorsally or slightly curved towards interior of mouth.



**FIGURE 8.** *Serrapinnus sterbai* (a) male, MZUSP 40359, 22.8 mm SL, Município de Arraias, periodic lake in the confluence of rio Paraná and rio Bezerra, Tocantins drainage, Tocantins State, Brazil; (b) male, MZUSP uncat., not measured, and (c) female, MZUSP uncat., not measured.

Dorsal-fin rays ii,9(30). Dorsal-fin origin at midlength of SL. First unbranched dorsal-fin ray about one-half length of second unbranched dorsal-fin ray; following branched rays decreasing in size posteriorly. Adipose-fin origin slightly posterior to or along vertical through base of last anal-fin ray. Anal-fin rays iii–iv,16(1), 17(3), 18(8), 19(17) or 21(1). First unbranched anal-fin ray only observable in cleared and stained specimens. Distal border of anal-fin concave; last unbranched and 5–6 anterior branched rays longest; remaining rays decreasing in size posteriorly. Tip of depressed anterior anal-fin rays of mature males laterally overlapping last anal-fin rays; sometimes reaching ventral procurrent caudal-fin rays in arched caudal peduncle. Anal-fin origin posterior to

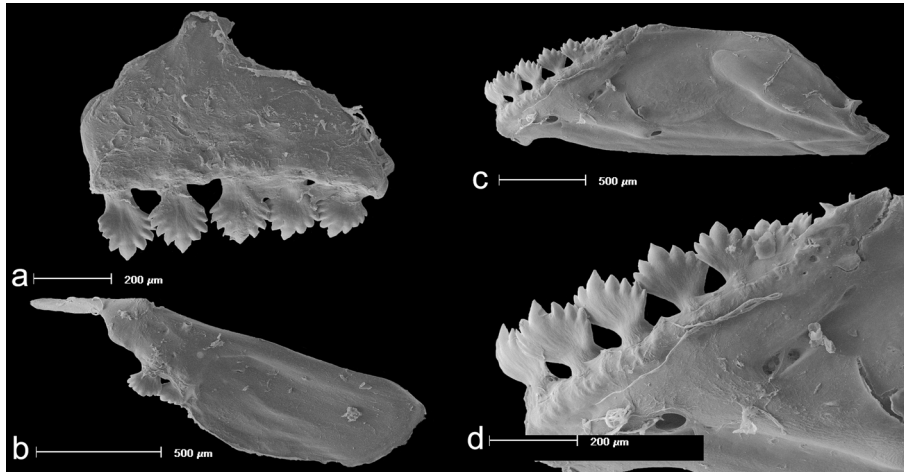
vertical through insertion of last dorsal-fin ray. Males with acute, elongate, retrorse hooks on anal-fin rays; hooks posterolaterally arranged on last unbranched to 7<sup>th</sup> or 8<sup>th</sup> branched rays (Fig. 4c). Two or three unpaired hooks per lepidotrichia segment on each contralateral half of ray. Hooks distributed along distal half of anal-fin rays on posterior and rarely anterior margins of rays. Rays segments and branches bearing hooks progressively fused during maturation. Mature males with hypertrophied soft tissue on interradiial membrane anterior to hook bearing anal-fin rays. Pectoral-fin rays i,9(18), 10(11) or 11(1). Tip of pectoral fin reaching pelvic-fin origin in immature and females; extending beyond that point in mature males. Pelvic-fin rays i,7(30). Pelvic-fin origin anterior to vertical through dorsal-fin origin. Longest pelvic-fin ray not reaching anal-fin origin in immature and females, but extending beyond that point in mature males. Males with one or two acute elongate hooks per lepidotrichia segment of all pelvic-fin rays; hooks ventral-medially aligned. Mature males with hypertrophied soft tissue on interradiial membrane anterior to hooks and ventral surface of pelvic fin. Principal caudal-fin rays 19(29) or 20(1). Procurrent caudal-fin rays: dorsal 12(3) or 13(1); ventral 15(3) or 17(1). Mature males with ventral procurrent caudal-fin rays hypertrophied and contralateral elements fused; rays extending beyond ventral caudal-peduncle muscles and skin. Hypertrophied ventral procurrent rays rod-shaped, sometimes fused, anteriorly bent along their axes, proximally acute, slight expanded distally and ending in rounded to flat distal tip (Fig. 2e).

**TABLE 3.** Morphometric data for *Serrapinnus sterbai*. SD = Standard deviation.

	Males	Min	Max	Mean	SD	Females	Min	Max	Mean	SD
Standard length (mm)	15	22.8	29.7	26.3	2.6	16	22.4	31.8	26.7	3.0
Percent of standard length										
Head length	15	22.1	29.1	25.7	1.8	16	23.7	27.0	25.4	1.1
Bony head length	15	22.7	26.5	24.6	1.2	16	22.4	25.2	24.0	0.8
Snout-anal fin distance	15	61.3	69.4	64.4	2.5	16	64.7	71.2	67.8	1.6
Snout-dorsal fin distance	15	47.9	53.3	50.6	1.7	16	50.2	53.4	51.9	1.0
Snout-pelvic fin distance	15	43.3	50.7	46.9	2.2	16	45.2	50.3	47.3	1.4
Snout-pectoral fin distance	15	24.7	30.7	27.4	2.2	16	24.7	30.0	27.2	1.8
Dorsal-fin base length	15	12.6	15.2	14.1	0.8	16	12.6	14.4	13.6	0.6
Anal-fin base length	15	18.5	26.0	22.8	2.2	16	20.7	27.6	25.0	1.7
Length of caudal peduncle	15	13.1	17.4	15.1	1.3	16	12.2	16.5	14.1	1.1
Depth of caudal peduncle	15	12.7	16.1	14.2	1.1	16	11.5	15.7	12.6	1.0
Body depth at dorsal-fin	15	33.0	38.0	35.4	1.7	16	35.6	42.3	39.1	1.7
Dorsal-fin length	15	28.0	34.0	30.7	1.5	16	27.5	32.0	29.5	1.3
Pelvic-fin length	15	18.0	24.6	21.6	2.0	16	16.3	20.4	18.2	1.0
Pectoral-fin length	15	20.4	25.2	22.4	1.6	16	18.1	22.4	20.1	1.2
Percent of head length										
Snout length	15	22.6	26.9	24.6	1.5	16	22.0	26.5	23.9	1.4
Upper Jaw length	15	23.3	28.5	25.1	1.5	16	23.6	27.9	25.3	1.2
Horizontal orbit diameter	15	34.7	41.3	38.3	1.7	16	36.7	40.6	38.6	1.3
Interorbital width	15	29.1	35.1	32.8	1.7	16	29.2	34.3	32.3	1.4

Scales cycloid, similar in size over all body. Lateral line partially pored with 7(3), 8(9), 9(15), 10(3) pored scales, or rarely completely pored (MZUSP 83894, 83971). Scales in lateral-line series 31(4), 32(8), 33(10), 34(7) or 35(1). Predorsal scales in regular row 9(17), 10(10) or 11(3). Scale rows between lateral line and dorsal-fin origin 5(21) or 6(9). Scale rows between lateral line and pelvic-fin origin 4(30). Scale rows around caudal peduncle 12(1), 13(10) or 14(19). Axillary scale on pelvic fin base extends posteriorly over 1–2 scales. Scales along anal-fin base 9(1), 10(10), 11(8), 12(7), 13(3) or 15(1).

Counts based on four clear and stained specimens: Supraneurals 3(1) or 4(3); abdominal vertebrae 15(2) or 16(2); caudal vertebrae 17(2), 18(1) or 19(1).



**FIGURE 9.** *Serrapinnus sterbai*, UFRGS 16447, 28.7 mm SL; Scanning Electron Microscopy images showing (a) left side premaxilla; (b) maxilla; (c) dentary, and (d) detail of dentary teeth.

**Color in alcohol.** Overall ground coloration of body pale yellow. Dorsal region of head and body with higher concentration of melanophores. Body with longitudinal, midlateral dark stripe extending from posterior margin of opercle to caudal spot. Longitudinal black stripe one or one and half scale wide. Black, horizontally elongated spot at base of caudal fin extending posteriorly until midlength of central caudal-fin rays. Scales above longitudinal line with melanophores primarily along posterior border, resulting in faint reticulated pattern. Abdominal region lightly colored, almost without pigmentation. Dorsal, pectoral and pelvic fins mostly hyaline, with scattered melanophores along fin rays. Adipose fin not pigmented. Caudal fin covered with diffuse melanophores along fin rays, except for clear areas at base of each caudal-fin lobe just posterior of caudal-fin spot. Humeral region with triangular, dark area due to pseudotympanum within muscular hiatus (Fig. 8).

**Sexual dimorphism.** Sexually mature males have the following dimorphic characters: the presence of hooks on the pelvic and anal-fin rays; the ventrally arched caudal peduncle; the hypertrophied hook bearing anal-fin rays, expanded in the sagittal plane, and sometimes with a fusion of ray segments; the slightly elongate dorsal- and pelvic-fin rays; and the hypertrophied ventral procurrent caudal-fin rays extending ventrally through the musculature and skin (Figs. 2e–f, 4c, 8).

**Distribution.** *Serrapinnus sterbai* was described based on aquarium specimens. Zarske (2012) states that the imprecise type locality was the “region of Araguaia, eastern Brazil? (our translation). Our new records extend the distribution of *S. sterbai* to several tributaries and the main course of the rio Tocantins drainage (Fig. 5c).

**Remarks.** Zarske (2012) figured the holotype, a male specimen, three times in his paper: as a preserved specimen (Zarske, 2012: fig. 1), as a radiograph (Zarske, 2012: fig. 3) and as a live specimen in an aquarium (Zarske, 2012: fig. 4). The three images belong, however, to at least two different specimens, since the shape and profile of the procurrent fin rays in the alcohol preserved specimen is clearly different from that in the radiographed and live specimens. The same seems to occur with the female paratype shown as a preserved specimen in Zarske’s fig. 2 and as a radiograph in his fig. 3, since the body shape and body proportions differ between the figured specimens. The holotype catalogued as UFRJ 8516 was examined and photographed by Fernando R. Carvalho at the Museum für Tierkunde, Dresden. The shape and number of anal fin hooks allowed him to recognize it as the specimen showed in radiograph (Zarske, 2012: 7, fig. 3), but not as the specimen labeled as holotype in Zarske (2012: 6, fig. 1). Examining the radiograph in Zarske (2012: fig. 3) we observe that the second and longest unbranched ray of dorsal fin is anomalous at its midlength and near the tip of the first unbranched ray of dorsal fin. The same anomaly can be seen in the specimen photographed alive in Zarske (2012: 8, fig. 4). Accordingly, specimens labeled as the holotype in Zarske’s figs. 3 and 4 are actually images of the holotype. The specimen erroneously listed as the holotype in Zarske (2012: fig. 1) is a paratype male of MTD F 32658-32664. The female labeled as the allotypus of fig. 2 in Zarske (2012) also does not correspond to the specimen catalogued as allotype under MTD F 32657, but rather to one of the paratypes at MTD F 32658-32664.

**Material examined.** All from Brazil, rio Tocantins-Araguaia basin. **Goiás State:** MZUSP 40375, 12, 14.5–20.9 mm SL, rio Macacos, tributary of left margin of rio Paraná, Fazenda Fortaleza, Município de Flores de

Goiás. MZUSP 40470, 4, 14.2–21.8 mm SL, Poço da Gandaia, marginal pond of rio Paraná, Fazenda Olho d'água, Município de Flores de Goiás. MZUSP 40511, 13, 11.4–24.9 mm SL (2 males 24.5–24.9 mm SL, 1 female 22.4 mm SL), pond close to highway GO 236, Município de Flores de Goiás. MZUSP 40518, 33, 12.5–22.9 mm SL, tributary of rio Corrente, on highway GO 236, 15 km from Alvorada de Goiás. MZUSP 40701, 2, 23.9–26.5 mm SL, rio Bezerra, tributary on left margin of rio Paraná, Município de Flores de Goiás. **Tocantins State:** MZUSP 40359, 69, 22.2–26.7 mm SL, 4c&s, 23.6–25.8 mm SL (13, 22.8–25.7 mm SL), Brazil, Tocantins, Município de Arraias, temporary pond on rio Paraná and rio Bezerra confluence, Tocantins drainage. MZUSP 83894, 19 of 52, 23.7–34.5 mm SL, Brazil, Tocantins, Porto Alegre do Tocantins, rio Manuel Alves da Natividade, 11°36'41''S 47°02'39''W. MZUSP 83971, 40 of 444, 18.7–35.2 mm SL, Brazil, Tocantins, Porto Alegre do Tocantins, rio Manuel Alves da Natividade, 11°36'41''S 47°02'39''W. UFRGS 16447, 24, 28.3–31.7 mm SL (10, 27.8–31.7 mm SL, 2c&s males 28.7–29.7 mm SL, 2c&s females 28.6–28.7 mm SL), Município de Paraná, Maranhão pond, Fazenda Traçadal. UNT 6621, 1, 20.6 mm SL, Município de Peixe, rio Tocantins, near confluence with rio Santa Tereza. UNT 7227, 28, 27.3–32.5 mm SL, Município de Paraná, Maranhão pond, Fazenda Traçadal. UNT 7322, 1, 18.0 mm SL, Município de Porto Nacional, rio Tocantins. UNT 7324, 1, 16.4 mm SL, Município de Ipueiras, rio Tocantins, near confluence with rio Manoel Alves. UNT 7386, 3, 15.5–21.2 mm SL, Município de Paraná, Maranhão pond, Fazenda Traçadal. UNT 7402, 1, 18.2 mm SL, Município de Paraná, Maranhão pond, Fazenda Traçadal. UNT 7403, 4, 19.6–25.2 mm SL, Município de Paraná, Maranhão pond, Fazenda Traçadal. UNT 7412, 1, 29.5 mm SL, Paraná, Maranhão pond, Fazenda Traçadal.

***Serrapinnus tocaninensis* Malabarba & Jerep n. sp.**

Figs. 2g–h, 4d, 5d, 10, 11

**Holotype.** UFRGS 16442, 32.5 mm SL, male, Brazil, Mato Grosso, Município de Barra do Garças, córrego Fundo, tributary of rio das Garças, 16°52'40.5''S 52°18'15.1''W, 8 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep.

**Paratypes.** All from Brazil, rio Tocantins-Araguaia basin. **Goiás State:** MCP 19987, 3, 33.5–37.0 mm SL, rio Tocantins, 3 km down on Serra da Mesa Dam, Município de Minaçu, 13°50'51''S 48°16'60''W, 6 Nov 1996, C. A. S. Lucena & J. F. P. Silva. MCP 19988, 8, 28.5–37.3 mm SL (6, 34.8–37.5 mm SL), rio Tocantins, at porto do Rubão, Município de Minaçu, 13°44'31''S 48°8'29''W, 7 Nov 1996, C. A. S. Lucena & J. F. P. Silva. MCP 42175, 1, 25.0 mm SL, headwaters of córrego Salobrona, tributary of rio Claro, Município de Montes Claros de Goiás, 16°02'38''S 51°22'11''W, 5 Jun 2007, G. A. Pereira. MCP 42269, 2, 24.8–31.6 mm SL, córrego Salobrona, tributary of rio Claro, Município de Montes Claros de Goiás, 15°56'19''S 51°20'58''W, 5 Jun 2007, G. A. Pereira. MCP 42360, 6, 16.0–29.4 mm SL, córrego Varginha, tributary of rio Claro, Município de Montes Claros de Goiás, 15°57'52''S 51°18'40''W, 5 Jun 2007, G. A. Pereira. MZUSP 4826, 33, 14.1–32.6 mm SL, rio Araguaia, Município de Aruan, 15–19 Sep 1966, Exc. DZ. MZUSP 40362, 27, 23.6–29.8 mm SL, 4c&s, 26.0–30.1 mm SL (6, 26.6–29.9 mm SL), marginal lagoon of riacho Seco, close to bridge on highway GO 447, Município de Galheiros, 14 Jan 1989, J. C. Oliveira & W. Costa. MZUSP 40378, 36, 13.2–21.8 mm SL, rio Macacos (also Macaquinhos), tributary at right margin of rio Paraná, Fazenda Fortaleza, Município de Flores de Goiás, 10 Sep 1988, J. C. Oliveira & W. Costa. MZUSP 40497, 12, 14.3–21.9 mm SL, rio Paraná, waterfall at Fazenda Olho d'Água, Município de Flores de Goiás, 12 Sep 1988, J. C. de Oliveira & W. J. M. Costa. MZUSP 40547, 5, 17.9–22.2 mm SL, rio Prata, bridge on highway GO 112, Município de Iaciara, 14 Sep 1988, J. C. Oliveira & W. J. M. Costa. MZUSP 40704, 4, 31.1–34.2 mm SL, rio Bezerra, tributary at right margin of rio Paraná, Município de Flores de Goiás, 22 Sep 1988, J. C. Oliveira & W. Costa. MZUSP 40858, 6, 20.9–26.0 mm SL, rio Paraná, between rio Macaco and rio Bezerra, Município de Monte Alegre de Goiás, Sep 1988, J. C. Oliveira & W. Costa. UFRGS 12021, 7, 27.9–31.3 mm SL, same data as holotype. UFRGS 12028, 20, 14.1–26.3 mm SL, rio das Almas, between Aragarças and Jussara, Município de Aragarças, 15°52'2.4''S 51°38'57.7''W, 6 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. UFRGS 12035, 5, 26.8–32.8 mm SL, stream tributary of rio Claro, between Aragarças and Jussara, Município de Aragarças, 15°52'10.8''S 51°32'56.6''W, 6 Feb 2010, V. A. Bertaco, F. R. Carvalho & F. C. Jerep. **Tocantins State:** MZUSP 115013, 2, 26.5–27.3 mm SL, temporary pond on rio Paraná and rio Bezerra confluence, Município de Arraias, 11 Jan 1989, J. C. Oliveira & W. Costa. UFRJ 1708, 24, 20.8–29.8 mm SL, tributary of rio Verde, 50 km from São Miguel do Araguaia, 28 Aug 1993, W. Costa, E. Vicente, M. Britto, F. Autran & R. D'Arrigo. UNT 4143, 2, 25.1–25.2 mm SL, Lagoa Dionísio, Fazenda Água Branca, Município de

Peixe, 11 March 2000, NEAMB-UFT. UNT 4265, 18, 20.0–26.8 mm SL, Lagoa Maranhão, Fazenda Traçada, Município de Paraná, 18 Nov 1998, NEAMB. UNT 4757, 30, 16.7–27.2 mm SL, Lagoa Água Branca at Fazenda Água Branca, Município de Peixe, 21 Aug 2001, NEAMB-UFT. UNT 7321, 20, 18.2–26.1 mm SL, rio Tocantins, Fazenda Traçada, Município de Paraná, 10 May 2000, NEAMB-UFT. **Mato Grosso State:** MCP 34172, (4, 29.2–31.7 mm SL), córrego Barreiro, tributary of rio São João on road to Vila Berrante, ribeirão Cascalheira 12°57'39"S 51°40'56"W, 28 Jul 2003, T. Carvalho & G. Carvalho. MCP 40417, 58, 19.2–36.2 mm SL (8, 32.5–36.1 mm SL, 3c&s, 30.6–33.4 mm SL), stream on highway BR158, 61 km south of Porto Alegre do Norte, 11°22'28"S 51°39'42"W, 28 October 2005, J. F. P. Silva. MCP 40473, (4, 25.9–30.3 mm SL), córrego Pium, 22 km south of Posto da Mata, on highway BR158 between Posto da Mata and Al Brasil, 11°53'58"S 51°39'26"W, 29 Oct 2005, J. F. P. Silva. MCP 40263, 89, 16.1–25.4 mm SL, rio Crisostomo on highway BR158 between Vila Rica and Confresa, Município de Vila Rica, 10°14'33"S 51°10'08"W, 26 Oct 2005, J. F. P. Silva. MCP 44522, 62, 9.4–20.4 mm SL, ribeirão São Marcos on highway BR158 between Confresa and Vila Rica, Município de Vila Rica, 10°06'05"S 51°06'00"W, 23 Apr 2006, J. F. P. Silva & L. Cotrim. MCP 44526, 32, 9.8–19.0 mm SL, ribeirão Santana 30 km north of Vila Rica on highway BR158, Município de Vila Rica, 09°49'11"S 51°03'21"W, 23 Apr 2006, J. F. P. Silva & L. Cotrim. MCP 44527, 21, 15.8–23.1 mm SL, rio Crisostomo on highway BR158 between Vila Rica and Confresa, 10°14'33"S 51°10'08"W, 22 Apr 2006, J. F. P. Silva & L. Cotrim. MCP 44530, 8, 10.6–19.1 mm SL, rio Tapirapé, Município de Porto Alegre do Norte, 10°51'00"S 51°37'00"W, 22 Apr 2006, J. F. P. Silva & L. Cotrim. MCP 44532, 3, 11.1–28.8 mm SL, rio Preto on highway BR158, 72 km south of Porto Alegre do Norte, 11°27'47"S 51°40'42"W, 21 Apr 2006, J. F. P. Silva & L. Cotrim. MCP 44534, 20, 18.6–30.1 mm SL, rio Paciguara 2 km north of Confresa on highway BR158, Município de Confresa, 10°37'34"S 51°32'51"W, 22 Apr 2006, J. F. P. Silva & L. Cotrim. MCP 44535, 10, 9.5–22.6 mm SL, rio Xavantinho 16 km South of Porto Alegre do Norte, 11°01'30"S 51°38'47"W, 21 Apr 2006, J. F. P. Silva & L. Cotrim. **Par State:** INPA 20976, 32, 27.9–36.4 mm SL (8, 30.6–35.1 mm SL), Igarapé Canoal, Município de Breu Branco, 12 Nov 1981, equipe de Ictiologia INPA. INPA 20977, (6, 28.3–34.4 mm SL), Igarapé tributary of rio Sossego, Município de Parauapebas, Cana Carajás, 14 Mar 2002, G. Mendes. INPA 20978, 13, 18.4–32.7 mm SL (4, 29.1–31.7 mm SL), Igarapé tributary of rio Sossego, Município de Parauapebas, Cana dos Carajás, 14 Mar 2002, G. M. Santos. INPA 20979, 7, 24.5–35.3 mm SL, Igarapé Bacuri, 6 Jul 1982, equipe de Ictiologia INPA. INPA 20984, 20, 31.5–36.8 mm SL (5, 32.2–36.5 mm SL), Igarapé Bacuri, 26 Nov 1981, Eq. Ictiologia INPA. INPA 20986, 27, 32.4–39.8 mm SL (7, 35.0–39.7 mm SL, 3c&s, 34.3–35.0 mm SL), Igarapé Bacuri, close to DNER, 26 Nov 1981, equipe de Ictiologia INPA. MCP 24199, 8, 28.9–32.8 mm SL, Igarapé Cinzento, tributary on left margin of rio Itacaiúnas, 05°51'1"S 50°32'7"W, Jul 1997, P. S. Pompeu. MZUSP 4936, 188, 11.4–34.6 mm SL, tributary of rio Araguaia, highway Belém-Brasília, 30 km North of Gurupi, 31 May 1966, Expedition DZUSP. MZUSP 18144, 30, 21.8–29.4 mm SL, lagoon in front of Jatobal, 17 Sep 1970, EPA. **Distrito Federal:** USNM 292213, 1, 33.8 mm SL, rio Maranhão, about 35 km north of Brasília, 15°30'S 47°50'W, 14 Nov 1984, W. C. Starnes, M. Ribeiro, R. Mendonça, *et al.*

**Diagnosis.** *Serrapinnus tocantinensis* can be diagnosed from its congeners by the elongation of the unbranched dorsal and pelvic-fin rays into filaments in mature males. Furthermore *S. tocantinensis* can be distinguished from *S. sterbai* by the absence of a continuous mid-lateral black stripe extending from the opercular region to the caudal-peduncle spot, and from the remaining species of the genus by the presence of 9 to 11 cusps in the premaxillary teeth (*vs.* 5 in *S. microdon* and *S. potiguar*, 7 in *S. aster*, 7 to 9 in *S. calliurus*, *S. heterodon*, *S. kriegi*, *S. micropterus*, *S. notomelas* and *S. piaba* and 10 to 12 in *S. gracilis* and *S. littoris*), dentary teeth without expanded cusps forming a sharp cutting edge (*vs.* dentary teeth with expanded cusps forming a sharp cutting edge in *S. heterodon*), hyaline dorsal fin (*vs.* with a proximal black blotch in *S. notomelas*), and the absence of a black spot on the posteroventral region of the abdomen (*vs.* the presence of a black spot in that region in *S. kriegi*).

**Description.** Morphometric data presented in Table 4. Body elongated and compressed. Greatest body depth at dorsal-fin origin. Snout anteriorly rounded in lateral profile. Dorsal profile of head gently convex from vertical through posterior margin of posterior nares to base of supraoccipital spine, then straight to slightly concave to tip of supraoccipital spine. Predorsal profile slightly convex between tip of supraoccipital spine and dorsal-fin origin. Straight to slightly convex along dorsal-fin base. Dorsal profile from insertion of last dorsal-fin ray to adipose fin slightly convex in immatures and females; deeply convex in mature males with ventrally arched caudal peduncle. Dorsal profile straight to slightly concave from adipose-fin base to most anterior dorsal procurrent caudal-fin ray. Distal tip of lower jaw convex. Ventral profile of head straight to gently convex along ventral profile lower jaw to



vertical through posterior margin of eye; convex from that point to pelvic-fin origin. Ventral region from pelvic-fin insertion to anal-fin origin slightly concave to straight in immature and females; deeply concave in mature males. Anal-fin base slightly concave in immature and females; distinctly convex anteriorly and straight posteriorly in mature males. Ventral profile of caudal-peduncle slightly concave in females; distinctly convex in mature males due to hypertrophied procurrent caudal-fin rays extending ventrally through muscles and skin (Figs. 2g–h, 10). Caudal peduncle slightly longer than deep; ventrally arched in alcohol preserved mature males. Head anteriorly tapered in lateral view. Posterior margin of opercle sinusoidal with upper portion concave and lower portion convex. Mouth terminal, mouth slit just below horizontal through middle of pupil. Maxilla angled posteroventrally; posterior tip reaching vertical through anterior border of orbit and horizontal through ventral border of orbit. All teeth multicuspitate, pedunculate, compressed and expanded distally (Fig. 11). Premaxillary teeth 5(5) with 9 to 11 cusps; central cusp slightly longer and wider than lateral cusps. Two (4) maxillary teeth with 7 to 9 cusps. Dentary teeth 6(1), 7(2) or 8(3) with 7 to 9 cusps, rarely followed by one smaller tricuspid teeth. Lateral small cusps of dentary teeth overlapping adjacent tooth cusps; overlap usually not present on posterior teeth. All dentary tooth cusps dorsally pointed or slightly recurved towards interior of mouth.



**FIGURE 10.** *Serrapinnus tocantinensis*, (a) holotype, male, UFRGS 16442, 32.5 mm SL, córrego Fundo, tributary of rio das Garças, Município de Barra do Garças, Mato Grosso, Brazil; (b) paratype, female, UFRGS 12021, 29.9 mm SL, same data as holotype.

Dorsal-fin rays ii,8(2), 9\*(65). Dorsal-fin origin slightly anterior to vertical through midlength of standard length. First unbranched dorsal-fin ray about one-half length of second unbranched dorsal-fin ray. Second unbranched dorsal-fin ray longest in fin with branched rays slightly decreasing in size posteriorly. Second unbranched dorsal-fin ray elongated into small filament in mature males. Adipose-fin origin slightly anterior to vertical through base of last anal-fin ray in females and slightly posterior to that point in males. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Anal-fin rays iii–iv,15\*(1), 17(2), 18(19), 19(33), 20(10) or 21(1). Distal border of anal-fin concave; last unbranched and anterior 5–6 first branched rays longest; ray length abruptly decreasing after sixth ray with remaining rays decreasing in size to end of anal fin. Distal tip of longest anal-fin ray of mature males reaching to vertical through base of last anal-fin ray; sometimes reaching ventral procurrent caudal-fin rays when caudal peduncle deeply arched. Males with acute, elongate, retrorse hooks on

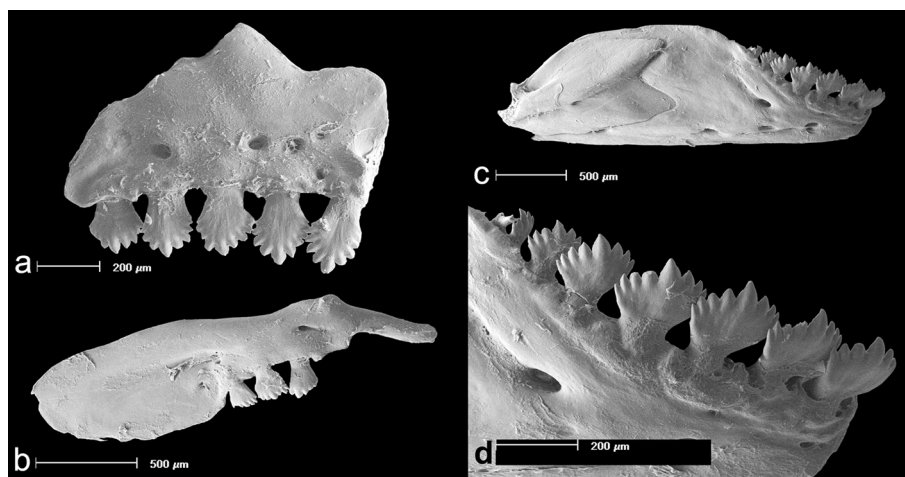
distal half of anal-fin rays; hooks posterolaterally arranged on last unbranched to 11<sup>th</sup> or 17<sup>th</sup> branched rays. Two or 3 unpaired hooks per ray segment of each contralateral lepidotrichia (Fig. 4d). Hooks generally situated on posterior margin of posterior ray branches. Hook bearing ray segments and branches progressively fused during maturation of males. Mature males with hypertrophied soft whitish tissue on interradial membrane anterior to anal-fin hooks. Pectoral-fin rays i,9\*(18), 10(36) or 11(13). Pectoral-fin ray reaching pelvic-fin origin in immatures and females, but extending beyond that point in adult males. Pelvic-fin rays i,6(2) or 7\*(65). Pelvic-fin origin slightly anterior to vertical through dorsal-fin origin. Pelvic fin falling short of anal-fin origin in immature and females; extending far beyond that point in adult males. Males with one or two acute, elongate, ventral-medially situated hook per lepidotrichia segment on all pelvic-fin rays. Adult males with hypertrophied soft whitish tissue anterior to hooks on ventral surface of pelvic fin. Principal caudal-fin rays 17(2) or 19\*(65). Procurrent caudal-fin rays: dorsal 12(2), 13(1) or 15(3); ventral 12(1), 13(2) or 14(3). Adult males with ventral procurrent caudal-fin rays hypertrophied, commonly fused, with distal tips extending beyond muscles and skin of caudal-peduncle. Hypertrophied ventral procurrent caudal-fin rays elongated, rod-shaped, anteriorly bent, proximally acute and slightly expanded distally (Fig. 2g).

**TABLE 4.** Morphometric data for *Serrapinnus tocantinensis*. SD = Standard deviation. Male range includes holotype.

	Holotype	Males	Min	Max	Mean	SD	Females	Min	Max	Mean	SD
Standard length (mm)	32.5	34	25.9	35.6	31.6	3.0	32	26.9	39.7	33.6	3.0
Percent of standard length											
Head length	25.5	34	22.9	27.4	24.3	1.1	32	22.0	25.8	24.0	0.8
Bony head length	25.2	34	23.3	27.0	24.6	0.9	32	22.6	25.0	23.9	0.7
Snout-anal fin distance	61.5	34	60.9	69.1	64.7	2.0	32	64.1	71.6	67.0	2.0
Snout-dorsal fin distance	48.9	34	47.8	55.3	50.5	1.4	32	49.7	53.6	51.6	1.0
Snout-pelvic fin distance	44.9	34	43.6	50.8	46.5	1.5	32	45.8	50.7	47.6	1.3
Snout-pectoral fin distance	25.5	34	23.4	29.1	25.2	1.2	32	22.2	27.1	24.7	1.1
Dorsal-fin base length	15.1	34	12.3	15.8	13.9	0.8	32	12.5	15.0	13.7	0.6
Anal-fin base length	22.2	32	20.8	25.7	23.3	1.1	32	21.5	27.2	24.9	1.2
Length of caudal peduncle	18.8	32	14.5	18.8	16.5	1.2	32	12.5	16.9	15.1	1.0
Depth of caudal peduncle	15.7	34	11.5	15.7	13.4	1.0	32	10.0	14.0	12.4	0.9
Body depth at dorsal-fin	34.5	34	29.2	38.1	33.1	2.1	32	31.6	40.4	36.4	2.4
Dorsal-fin length	37.8	33	28.2	37.9	31.3	2.3	30	26.3	31.9	29.3	1.5
Pelvic-fin length	25.2	34	18.3	26.8	21.9	2.3	32	15.1	19.1	17.4	1.1
Pectoral-fin length	24.9	34	19.6	25.9	22.8	1.5	32	17.9	23.7	20.4	1.2
Percent of head length											
Snout length	28.9	34	25.7	31.0	28.1	1.3	32	23.0	30.4	26.9	1.5
Upper Jaw length	28.9	34	25.3	30.6	27.6	1.2	32	25.3	31.2	27.4	1.4
Horizontal orbit diameter	37.3	34	34.3	43.0	37.7	2.0	32	33.3	41.0	37.7	1.9
Interorbital width	31.3	34	28.4	35.8	32.4	1.5	32	28.4	35.5	31.9	1.7

Scales cycloid; similar in size over all body. Lateral line partially pored with 8(1), 11(5), 12(2), 14(7), 15(4), 16(2), 17(6), 18(2), 19(2), 20(2), 21(1), 23(1), 32(5), 33(7), 34(11), 35\*(7) or 36(2) pored scales. Scales in lateral-line series 31(3), 32(9), 33(22), 34(16), 35\*(15) or 36(2). Predorsal series in regular row 8(1), 9\*(9), 10(34) or 11(23). Scale rows between lateral line and dorsal-fin origin 5(49) or \*6(18). Scale rows between lateral line and pelvic-fin origin 4\*(64) or 5(3). Scale rows around caudal peduncle 12(3), 13(24), 14\*(36) or 15(4). Axillary scale on pelvic fin base extending posteriorly one or two scales. Scales along anal-fin base 9(4), 10(12), 11(24), 12(14), 13(6), 14(2), 15\*(3) or 17(1).

Counts based on six clear and stained specimens: supraneurals 4(4) or 5(2); abdominal vertebrae 15(5) or 16(1); caudal vertebrae 19(4) or 20(2).



**FIGURE 11.** *Serrapinnus tocantinensis*, INPA 20986, 36.2 mm SL; Scanning Electron Microscopy images showing (a) right side premaxilla; (b) maxilla; (c) dentary, and (d) detail of dentary teeth.

**Color in alcohol.** Overall ground coloration of body pale yellow, darker dorsally from head to caudal peduncle. Body with faint dark, sometimes silver, midlateral stripe usually forming black line along middle longitudinal body axis. Longitudinal stripe extending from region slightly anterior to vertical through dorsal-fin origin to caudal spot. Scale series above longitudinal line with darker chromatophores mostly on posterior border of scales, resulting in faint reticulated pattern. Abdominal region ventral to longitudinal line more lightly colored and without pigmentation. Caudal spot rounded, black, situated over posterior of caudal peduncle and base of middle caudal-fin rays, but falling short of upper or lower margin of peduncle. Fins mostly hyaline with scattered, sparse, dark chromatophores. Adipose fin unpigmented. Caudal fin with dark chromatophores along fin rays, except for clear areas on base of each caudal-fin lobe. Humeral region with triangular, dark area due to pseudotympanum in musculature (Fig. 10).

**Sexual dimorphism.** Mature males of *S. tocantinensis* have hooks on the pelvic and anal-fin rays. The caudal peduncle is ventrally arched, as commonly observed in species of *Serrapinnus*. The hook bearing anal-fin rays are hypertrophied, expanded in the sagittal plane, and sometimes have fused ray segments. Adult males also have the last unbranched dorsal-fin ray and the first pelvic-fin ray elongated, sometimes in a short filament. The ventral procurrent caudal-fin rays are hypertrophied in mature males, and extend ventrally through the caudal peduncle muscles and skin (Figs. 2g–h, 4d, 10).

**Distribution.** *Serrapinnus tocantinensis* is distributed throughout the rio Tocantins-Araguaia basin, from the upper to the lower portions of the system (Fig. 5d).

**Etymology.** The species name, *tocantinensis*, refers to the restricted geographic distribution of the species to the rio Tocantins-Araguaia basin. A noun in apposition.

### Key to the species of the Cheirodontinae occurring in the Atlantic drainages of northeastern Brazil, from the rio Tocantins-Araguaia to the rio Paraguaçu drainages

1. Lower lobe of caudal fin of males covered with cone shaped or papilla-like organs (see Malabarba *et al.*, 2004: figs. 1 to 4). A conspicuous small black spot present at midlength of first branched anal-fin ray of males (see Malabarba *et al.*, 2004: figs. 5–6 and 8). A dark brown nearly isosceles triangular shaped mark present in the area covering pelvic bone in males (see Malabarba *et al.*, 2004: fig. 9) ..... 2 (*Kolpotocheirodon*)
- 1'. Lower lobe of caudal fin of males not covered with cone shaped or papilla-like organs. Conspicuous black spots lacking on branched anal-fin rays. Triangular mark in area covering pelvic bone absent ..... 3
2. Dorsal fin lacking conspicuous black spots. 3–5 very small, vertical bars crossing lateral body stripe between pseudotympanum and area ventral to dorsal fin (see Malabarba *et al.*, 2004: fig. 8). Twelfth to the 14<sup>th</sup> or 15<sup>th</sup> principal caudal-fin rays of males bearing hooks ..... *Kolpotocheirodon theloura* (headwaters of São Francisco and Paraná river basins near Brasília, DF, Brazil)
- 2'. Conspicuous small black spot present on soft tissue between midlength of first and second, and second and third dorsal-fin branched rays (see Malabarba *et al.*, 2004: figs. 5 and 6). Vertical bars crossing lateral body stripe and hooks on caudal fin

	absent. . . . .	<i>Kolpotocheirodon figueiredoi</i> (Paraguçu River drainage)
3.	Base of lower caudal-fin lobe with hypertrophied group of scales forming small pouch . . . . .	<i>Compsura heterura</i> (São Francisco River basin and northeastern coastal drainages; absent in Tocantins-Araguaia River basin)
3'.	Base of lower caudal-fin lobe without hypertrophied scales . . . . .	4
4.	Ventral procurent caudal-fin rays not hypertrophied or exposed along ventral margin of caudal peduncle of mature males. Thirteenth to 14 <sup>th</sup> caudal-fin rays bearing hooks associated with hypertrophied skin flaps in mature males (Malabarba & Weitzman, 1999: figs. 3–6). . . . .	<i>Acinocheirodon melanogramma</i> (São Francisco and Jequitinhonha river basins)
4'.	Ventral procurent caudal-fin rays hypertrophied and exposed ventrally in mature males. Caudal-fin rays without hooks or hypertrophied skin flaps in mature males . . . . .	5
5.	First through fourth or fifth branched anal-fin rays of mature males slab-shaped (Malabarba & Jerep, 2012: fig. 3). Distal tip of ventral procurent caudal-fin rays conical in mature males (Malabarba & Jerep, 2012: fig. 3). Anal-fin rays iv–v, 14–17. Lateral line completely pored with 32–36 scales . . . . .	<i>Ctenocheirodon pristis</i> (Tocantins-Araguaia River basin)
5'.	First through sixth or eighth branched anal-fin rays of mature males slab-shaped (Fig. 4). Distal tip of ventral procurent caudal-fin rays spatulate or scimitar-shaped in mature males (Fig. 2). Anal-fin rays iii–iv, 16–21 . . . . .	6 ( <i>Serrapinnus</i> )
6.	Three central cusps of dentary teeth expanded relative to other cusps and form a sharp-cutting edge. Lateral line completely pored . . . . .	<i>Serrapinnus heterodon</i> (São Francisco River basin and northeastern Atlantic coastal drainages)
6'.	Three central cusps of dentary teeth similar in shape to remaining cusps (Figs. 3, 7, 9, 11). Lateral line incomplete, with 5–10 pored scales (variable in <i>S. tocantinensis</i> , ranging from 6–36 scales) . . . . .	7
7.	Longitudinal black stripe wide and conspicuous, one or one and half scale deep, extending from posterior margin of opercle to caudal spot (Fig. 8) . . . . .	<i>S. sterbai</i> (Tocantins-Araguaia River basin)
7'.	Longitudinal black stripe narrow, extending from region below dorsal-fin base to caudal spot . . . . .	8
8.	Longest unbranched dorsal- and pelvic-fin rays of males prolonged as filament (Fig. 10) . . . . .	<i>S. tocantinensis</i> (Tocantins-Araguaia River basin).
8'.	Longest unbranched dorsal- and pelvic-fin rays of males not prolonged as filament. . . . .	9
9.	Ventral procurent caudal-fin rays 17–19 . . . . .	<i>S. lucindai</i> (Tocantins-Araguaia River basin)
9'.	Ventral procurent caudal-fin 16 or fewer. . . . .	10
10.	Ventral procurent caudal-fin rays of mature males spatulate, forming keel along posterior ventral margin of caudal peduncle . . . . .	<i>S. piaba</i> (São Francisco River basin and northeastern coastal Atlantic drainages)
10'.	Ventral procurent caudal-fin rays of mature males scimitar-shaped and forming semicircle, with portion of ventral procurent caudal-fin rays having resultant star-shape form with multiple points (Fig. 2a) . . . . .	11
11.	Premaxillary teeth with 7 to 9 cusps (Fig. 3a). . . . .	<i>S. aster</i> (Tocantins-Araguaia River basin).
11'.	Premaxillary teeth with 5 cusps (see Jerep & Malabarba, 2014: fig. 3) . . . . .	<i>S. potiguar</i> (Ceará-Mirim River basin in Rio Grande do Norte state).

## Discussion

No member of the Cheirodontinae was known to inhabit the rio Tocantins drainage until recently (Malabarba, 2003). The first cheirodontines from the entirety of the rio Tocantins only began to be known in 2012 with the descriptions of *Ctenocheirodon pristis* by Malabarba & Jerep (2012) and *Serrapinnus sterbai* by Zarske (2012); the new species described herein now add to the total. All five of these species (*C. pristis*, *S. aster*, *S. lucindai*, *S. sterbai*, and *S. tocantinensis*) are furthermore endemic to this drainage. This conforms to the pattern of ichthyofauna endemism in the Tocantins basin discussed by Bertaco & Carvalho (2010) and Bertaco *et al.* (2011) who listed 42 species endemic to the upper portions of the rio Tocantins system.

Species of *Odontostilbe* are relatively common and abundant across the Amazon basin (Bührnheim & Malabarba, 2006), in the río Orinoco drainage (Bührnheim & Malabarba, 2007) and in the Paraná-Paraguay basins (Malabarba, 2003). There is, however, a remarkable absence of records of this genus in the Tocantins-Araguaia basin.

The four species included herein possess the synapomorphies for *Serrapinnus* described by Malabarba (1998): the ventrally arched caudal peduncle in mature males (Figs. 1, 6, 8 and 10) and the ventral procurent caudal-fin rays not supported by the parhypural in males running perpendicular to the longitudinal axis of the body, with the anterior elements directed anteriorly in some species (Fig. 2). The four species also possess the synapomorphies of the tribe Cheirodontini (Malabarba, 1998; Malabarba & Jerep, 2012), including a high number of ventral procurent caudal-fin rays (13 in *S. aster*, 15–17 in *S. sterbai*, 12–14 in *S. tocantinensis*, and 17–19 in *S. lucindai*); the contralateral segments of each ventral procurent caudal-fin ray of males fused along their entire lengths and becoming progressively laminar with maturation (Fig. 2); the anterior ventral procurent caudal-fin rays of females have the proximal portions of their contralateral halves fused to each other, but retain an opening near their distal tips, resulting in a needle-like shape to these rays (see Malabarba, 1998:fig. 14); most of the anterior ventral

procurent caudal-fin rays of males project through the muscles and skin to form a keeled ventral margin to the caudal peduncle (Figs. 1, 6, 8 and 10); and the hemal spines of at least the four posterior caudal vertebrae anterior to terminal “half centrum” are elongated and associated with the ventral procurent caudal-fin ray support (Fig. 2).

All four species share an extension of the proximal and anterior ends of the bases of the lepidotrichia of the first anal-fin rays of males; very large ligaments of a diameter nearly equal to the diameter of the expanded anal-fin rays between the enlarged anal-fin rays of males with these ligaments connecting approximately the midlength of the posterior face of each proximal segment of the lepidotrichia to the proximal anterior face of each lepidotrichia of the subsequent ray; the anterior branched anal-fin rays 1 through 4 to 8 of males (usually those bearing hooks) slab-shaped and more expanded in the sagittal plane than comparable rays in females; the well-developed hooks only on the slab-shaped anal-fin rays; anal-fin hooks being bilaterally asymmetrical with an irregular arrangement differing in number, size, orientation, and/or position relative to those on the contra-lateral segments of the lepidotrichia (Fig. 4). This list of morphological synapomorphies was listed in Malabarba (1998) and discussed in a series of papers grouping *Serrapinnus* into a clade along with *Amazonspinther* (Bührnheim *et al.* 2008), *Ctenocheiroidon* (Malabarba & Jerep, 2012), *Heterocheiroidon* (Malabarba & Bertaco, 1999), *Megacheiroidon* (M. Malabarba, 1998), and *Spintherobolus* (Weitzman & Malabarba, 1999).

Recently, Mariguela *et al.* (2013) proposed *Serrapinnus* as polyphyletic in a phylogenetic analysis based on molecular data. This hypothesis was discussed by Jerep & Malabarba (2014). These later authors noted that almost all morphological evidences of relationships among cheiroidontine taxa were ignored by Mariguela *et al.* (2013) in their discussion, and a few morphological characters reported in that study were chosen to support their phylogeny in that they corroborate their cladogram. The acceptance of the Mariguela *et al.* (2013) hypothesis would require the recognition that the entire set of characters discussed arose multiple times in the Cheiroidontinae, a conclusion we refute.

The scimitar-shaped ventral procurent caudal-fin rays of mature males of *S. aster* (Fig. 2) and *S. potiguar* (Jerep & Malabarba, 2014: fig. 2) are unique among cheiroidontines and putatively a synapomorphy of those species. Mature males of *S. lucindai*, *S. sterbai* and *S. tocantinensis* have the anterior ventral procurent caudal-fin rays commonly fused to each other (Fig. 2), a feature not observed in any of the remaining species of *Serrapinnus*, and a modification that may represent a synapomorphy for those species. Within the Cheiroidontinae, the fusion of the anterior ventral procurent fin rays is observed in the species of *Spintherobolus* and in the fossil †*Megacheiroidon unicus*. The species of *Spintherobolus*, †*Megacheiroidon unicus* and *Amazonspinther dalmata*, however, are united by a series of synapomorphies not shared with *S. lucindai*, *S. sterbai* and *S. tocantinensis*, supporting the hypotheses of homoplasy of this character in these groups.

Dorsal and pelvic fins prolonged into a filament as observed in sexually dimorphic males of *S. tocantinensis* are unique among the species of the genus. Comparable modifications occur homoplastic in *Nanocheiroidon insignis* and in species of *Odontostilbe*. The wide longitudinal black stripe along the flank in *S. sterbai* is also unique to, and an autapomorphy of, that species.

Among the species of the tribe Cheiroidontini, a complete lateral line occurs in three species: *Serrapinnus heterodon*, the type species of the monotypic genera *Ctenocheiroidon* and †*Megacheiroidon*. *Serrapinnus tocantinensis* showed a variable number of pored lateral-line scales, ranging from 8 to 36 (the maximum number of scales along the longitudinal series of scales). We found no additional support for *S. tocantinensis* as being possibly related to *S. heterodon*.

**Comparative material examined.** *Acinocheiroidon melanogramma*: ANSP 176238, paratypes, 7, 21.9–26.2 mm SL, Brazil, Minas Gerais, rio Jequitai drainage. *Aphyodite grammica*: FMNH, holotype, 24.3 mm SL, Guiana, Konawaruk. MZUSP 29874, 20, 21.9–26.9 mm SL, Brazil, rio Negro. *Brittanichthys axelrodi*: MCP 14931, 17, 16.3–22.2 mm SL, 3 c&s, Brazil, Boa Vista, rio Negro. *Cheiroidon australe*: USNM 84317, paratypes, 12, 28.4–49.8 mm SL, Chile, Los Lagos region at Puerto Varas. *Cheiroidon dialepturus*: USNM 208524, holotype, 26.8 mm SL, Panama, Veraguas, rio San Pedro basin. *Cheiroidon galusdae*: USNM 84319, paratypes, 10, 30.6–52.3 mm SL, Chile, Río Locomilla at San Xavier. *Cheiroidon gorgonae*: USNM 64094, holotype, 22.1 mm SL, Panama, Canal Zone, small seepage pool below spillway of reservoir dam at Gorgona. *Cheiroidon kiliani*: USNM 227310, paratype, 1, 25.2 mm SL. Valdivia-Chile, Río Cau-Cau. *Cheiroidon microdon*: FMNH 57867, holotype, 32.2 mm SL, Brazil, Caceres, rio Ibicuhy. *Cheiroidon micropterus*: CAS 59780, holotype, 23.9 mm SL, Brazil, Pará, rio Amazonas drainage at Santarém. *Cheiroidon mitopterus*: USNM 208539, holotype, 34.6 mm SL, Panama, Cocle, rio Tucue, tributary of rio Cocle del Norte. *Cheiroidon notomelas*: FMNH 57829, holotype, 28.2 mm SL, Brazil,

Miguel Calmone. *Cheirodontops geayi*: USNM 121507, holotype, 35.5 mm SL, Venezuela, Estado de Aragua, río Guarico. *Compsura heterura*: FMNH 57825, holotype, 28.7 mm SL, Brazil, rio Itapicuru, Queimadas. *Holesthes heterodon* (= *Serrapinnus heterodon*): CAS 117522, paratypes, 4, 32.2–36.5 mm SL, Brazil, Minas Gerais, rio Grande, Jaguará. *Leptobrycon jatuaranae*: MCP 14936, 17, 20.8–25.1 mm SL, 3 c&s, Brazil, Amazonas, rio Negro. "*Macropsobrycon*" *xinguensis*: MCP 34546, 26, 18.6–29.1 mm SL, 3 c&s, Brazil, Mato Grosso, Nova Canaã do Norte, rio Kaiapá. *Microschemobrycon guaporensis*: FMNH 57926, holotype, 29.1 mm SL, Brazil, Maciel, rio Guaporé. *Odontostilbe hastatus*: FMNH 56383, holotype, 30.2 mm SL, Colombia, Soplaviento. *Oligobrycon microstomus*: holotype, 31.0 mm SL, Brazil, Jacarehy on rio Parahyba. *Oxybrycon* sp.: MCP 33105, 8, 13.7–14.9 mm SL, 2 c&s, Venezuela, Titi Lagoon, upper Río Orinoco basin. *Parecbasis cyclolepis*: FMNH 56677, holotype, 56.3 mm SL, Brazil, rio Madeira. MZUSP 26146, 7, 40.3–53.5 mm SL, Peru, Ucayali, rio Ucayali. *Pristella aubynei*: FMNH 52698, holotype, 34.9 mm SL, British Guiana. *Prodontocharax alleni*: CAS 117472, holotype, 32.8 mm SL, Peru, Ucayali, rio Amazonas basin. *Prodontocharax melanotus*: CAS 59793, holotype, 44.9 mm SL, Bolivia, La Paz, rio Amazonas drainage, Tumupasa. *Pseudocheirodon affinis*: CAS 117516, paratype, 10, 32.1–35.4 mm SL, Panama, rio Gatun, at Gatun. *Saccoderma melanostigma*: USNM 121519, holotype, 26.7 mm SL, Venezuela, rio San Juan, south of Mene Grande. *Spintherobolus broccae*: FMNH 58864, paratype, 1, 18.7 mm SL, Brazil, Rio de Janeiro. *Spintherobolus papilliferus*: FMNH 104802, holotype, 32.9 mm SL, Brazil, São Paulo, Alto da Serra. *Thrissobrycon pectinifer*: SU 16944, holotype, 26.8 mm SL, Brazil, Cucuhy, rio Negro. MCP 14932, 12, 26.4–30.2 mm SL, 3 c&s, Brazil, rio Arirara.

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