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Three new species of *Astyanax* from drainages of southern Brazil (Characiformes: Characidae)

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Three new species of *Astyanax* are described from southern Brazil: *A. dissensus* and *A. xiru* from the laguna dos Patos system and rio Uruguay basin, the first species also occurring in the rio Tramandaí system, and *A. procerus* from the laguna dos Patos system. *Astyanax procerus* and *A. xiru* possess outer row premaxillary teeth pentacuspid and inner row heptacuspid, maxillary with one tri- to pentacuspid teeth, 18-23 branched anal-fin rays, and two humeral spots. *Astyanax procerus* has the largest body depth (38.3-46.0% of SL), while *A. xiru* has the lowest body depth (32.5-37.5% of SL) among the three species. The characters combination can distinguish these species from its congeners. *Astyanax dissensus* distinguish from *Astyanax* species by the presence of one developed heptacuspid teeth on maxillary, 22-28 branched anal-fin rays, 35-39 perforated scales along the lateral line, two humeral spots, conspicuous lateral band continuous on middle caudal rays, 6-7 scale row between dorsal-fin origin and lateral line, and head length 22.7-27.3% of SL. All three species has the predorsal region of the body scaled. An identification key to the species of *Astyanax* species from the rio Uruguay basin, and laguna dos Patos and rio Tramandaí systems is provided.

Três espécies novas de *Astyanax* são descritas para o sul do Brasil: *A. dissensus* e *A. xiru* do sistema da laguna dos Patos e bacia do rio Uruguai, a primeira espécie ocorrendo também no sistema do rio Tramandaí e *A. procerus* do sistema da laguna dos Patos. *Astyanax procerus* e *A. xiru* possuem dentes da série externa do pré-maxilar pentacuspidados e da série interna heptacuspidados, um dente tri ou pentacuspidado no maxilar, 18-23 raios ramificados na nadadeira anal e duas manchas umerais. *Astyanax procerus* possui maior altura do corpo (38,3-46,0% do CP), enquanto *A. xiru* é uma espécie relativamente baixa (32,5-37,5% do CP). Estes caracteres, no conjunto, auxiliam a diagnosticar estas duas espécies das demais do gênero. *Astyanax dissensus* distingue-se das demais espécies por apresentar um desenvolvido dente com sete cúspides no maxilar, 22-28 raios ramificados na nadadeira anal, 35-39 escamas perfuradas na linha lateral, duas manchas umerais, uma faixa lateral contínua sobre os raios medianos da nadadeira caudal, 6-7 séries de escamas entre a origem da nadadeira dorsal e a linha lateral, comprimento da cabeça 22,7-27,3% do CP. Todas as três espécies novas possuem a região pré-dorsal com escama. Uma chave de identificação das espécies de *Astyanax* da bacia do rio Uruguai, e dos sistemas da laguna dos Patos e do rio Tramandaí é fornecida.

Key words: Laguna dos Patos system, Neotropical fish, Rio Grande do Sul, Rio Uruguay , Taxonomy.

Introduction

The genus *Astyanax* Baird & Girard is a speciose group of characiform fishes, comprising 138 valid species (Eschmeyer, 2012), and occurring in all Neotropical drainages from the Colorado River, Texas and New Mexico, USA (Ornelas-Garcia *et al*., 2008) to rio Colorado, northern of Patagonia, Argentina (Menni, 2004; López *et al*., 2008). *Astyanax* not represents a monophyletic entity as recent phylogenetic hypotheses, using morphological characters (Mirande, 2010) and molecular data (Javonillo *et al*., 2010; Oliveira *et al*., 2011). Due to it, the genus has been defined by a characters combination proposed nearly a century ago by Eigenmann (1921, 1927), as two rows of premaxillary teeth, five teeth in the inner premaxillary series, lateral line complete, adipose fin present, and caudal fin naked, but all these characters are also shared by other Characidae genera *(e.g.*, *Hyphessobrycon* Durbin, *Markiana* Eigenmann, *Moenkhausia* Eigenmann).

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With basis on the review study of *Astyanax* species from the rio Uruguay and laguna dos Patos system drainages, beyond of thirteen recognized species (*A. aramburui* Protogino, Miquelarena & López, 2006, *A. brachypterygium* Bertaco & Malabarba, 2001, *A. cremnobates* Bertaco & Malabarba, 2001, *A. eigenmanniorum* (Cope, 1894), *Astyanax* aff. *fasciatus*, *sensu* Melo & Buckup, 2006, *A. henseli* Melo & Buckup, 2006, *A. jacuhiensis* (Cope, 1894), *A. laticeps* (Cope, 1894), *A. obscurus* (Hensel, 1870), *A. ojiara* Azpelicueta & Garcia, 2000, *A. paris* Azpelicueta, Almirón & Casciotta, 2002, *A. saguazu* Casciotta, Almirón & Azpelicueta, 2003, and *A. stenohalinus* Messner, 1962), three new species were identified and here in described.

Material and Methods

Counts were taken as described by Fink & Weitzman (1974) and Bertaco & Lucena (2006). Counts of vertebrae, supraneurals, and procurrent caudal-fin ray counts were taken from cleared and stained (c&s) specimens prepared according to Taylor & van Dyke (1985). Tooth counts were taken in all specimens included in the table. Vertebral counts include the four vertebrae of the Weberian apparatus, and the terminal centrum counted as a single element. In the descriptions, an asterisk indicates counts of the holotype and the frequency of each count is provided in parentheses after the respective count. Lower and upper jaws of c&s specimens were prepared for scanning electronic microscopy.

Measurements were taken point to point with a caliper on the left side of specimens whenever possible. Measurements are expressed as percentage of standard length (SL) except for subunits of the head which are recorded as percentage of head length (HL) and follows Fink & Weitzman (1974). In the material examined, the catalog number is followed by the total number of the lot and, in parentheses, the number of specimens counted and measured and respective length range. In cases without parentheses, the range length corresponds to the smallest and largest specimens of the lot.

The specimens examined are deposited in the Asociación Ictiológica, La Plata (AI), Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires (MACN), Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre (MCN), Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP), Museo Nacional de Historia Natural y Antropologia, Zoologia, Seccion Ictiología, Ministerio de Educación y Cultura, Montevideo (MHNM), Museo de La Plata, Instituto de Limnologia, La Plata (MLP), Departamento de Zoologia, Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS), and Humboldt-Universität, Museum für Naturkunde, Zoologisches Museum, Vertebraten, Ichthyologie, Berlin (ZMB).

The laguna dos Patos system includes laguna dos Patos, laguna Mirim and all their tributaries, according to Malabarba (1989). The coastal plain of the rio Tramandaí drainage follows the definition of Malabarba & Isaia (1992). The almost fourteen tens valid species of *Astyanax*, the broad geographical distribution these species, the limited variability in morphological and color pattern among them, and the lack of a taxonomic study of the genus makes the diagnosis of new species too complicated. In addition, the descriptions of most of them are very limited, mainly of the species oldest. As a result, in the text, the Diagnoses include only the species described from the same drainage(s) where the news species occur. In the Discussion section we expand the comparison to with the species that occur in neighboring drainages, and in the São Francisco basin. With this we believe have diminished the likelihood of the new species are already described from the basins of the rio Amazonas, rio Tocantins-Araguaia, rivers of Guianas and trans-Andean basins. If this will be confirmed in the future, it would be a rare case of disjunction distribution. Reported cases of species with wide distribution so surely lack a thorough taxonomic analysis. The differences with the other species from the above mentioned basins will be made with the presentation of a set of characters based on comparative material examined and literature data.

The main literature used were: Eigenmann (1921, 1927), Géry (1972), Géry (1977), Lozano-Vilano & Contreras-Balderas (1990), Azpelicueta & Garcia (2000), Garutti & Britski (2000), Bertaco & Malabarba (2001), Melo (2001), Azpelicueta *et al*. (2002), Azpelicueta & Casciotta (2002), Azpelicueta *et al*. (2003), Casciotta *et al*. (2003), Triques *et al*. (2003), Casciotta & Almirón (2004), Castro & Vari (2004), Mirande *et al*. (2004), Miquelarena & Menni (2005), Casciotta *et al*. (2005), Protogino *et al*. (2006), Mirande *et al*. (2006, 2007), Vari & Castro (2007), Zanata & Camelier (2008, 2009), Bussing (2008), Garavello & Sampaio (2010), Soneira *et al*. (2010), and Tagliacollo *et al*. (2011).The *Astyanax* species complex employed in this study are *A. bimaculatus sensu* Garutti & Britski (2000) and *A. scabripinnis sensu* Bertaco & Lucena (2006). The data of *A. paranahybae* Eigenmann, 1911, following Garutti & Britski (2000), and according to Vari & Castro (2007). The morphological data of *A. trierythropterus* Godoy following Garutti & Britski (2000), and from *A. paranae* following Bertaco & Lucena (2006) and data of holotype provided by M. Weitzman (USNM).

Results

Astyanax dissensus Lucena &Thofehrn, new species
Figs. 1-2

Astyanax sp. 2. -Becker *et al*., 2013: 82 (listed).

Holotype. MCP 47000, 65.1 mm SL, Brazil, Rio Grande do Sul, Candiota, arroio Candiota, downstream of Thermoelectric Power Plant, rio Jaguarão drainage, 31º34’36”S 53º40’22”W, 16 Feb 2001, R. E. Reis, C. M. Joenck & T. Borges.

Fig. 1. *Astyanax dissensus*, new species, MCP 47000, 65.1 mm SL, holotype, arroio Candiota, rio Jaguarão drainage, Candiota, Rio Grande do Sul, Brazil.

Paratypes. Brazil, Rio Grande do Sul State, laguna dos Patos system. MCN 19585, 2, 58.9-66.1 mm SL, MCP 17361, 31(28, 47.6-75.7 mm SL, 1 c&s 53.1 mm SL), UFRGS 17097, 2, 40.2-66.2 mm SL, arroio Taquara, road of Boa Vista *ca.* 5 km of road BR-290, Minas do Leão, *ca.* 30º09'S 52º02'W, 24 Nov 1993, J. F. P. da Silva & W. Bruschi. MCP 34788, 3 (2, 52.1-65,1 mm SL), tributary of rio Basílio, *ca*. 25 km to NW of Herval, 31º52'12"S 53º30'40"W, 16 Nov 2003, R. E. Reis, P. Lehmann, M. Abreu & C. Alho. MCP 47404, 2, 40.4-44.8 mm SL, arroio Paraíso, locality of Rincão da Porta, Cachoeira do Sul, *ca.* 29º41'S 53º09'W, 15 Sep 1993, C. A. S. Lucena, J. F. P. da Silva & V. A. Bertaco. MCP 47407, 1, 56.1 mm SL, arroio Hilário on the road Caçapava do Sul - Lavras do Sul, Lavras do Sul, 30º46'03"S 53º48'23"W, 26 Apr 2000, C. A. S. Lucena, J. F. P. da Silva & V. A. Bertaco. MCP 47409, 1, 60.3 mm SL, arroio Reduzindo on the road Pedro Osório - Basílio, rio Piratini drainage, 31º54'32"S 52º35'59"W, 20 Nov 1999, C. A. S. Lucena, Z. M. S. Lucena, E. H. L. Pereira & V. A. Bertaco. MCP 43236, 6, 43.1-62.9 mm SL, stream tributary of rio Jaguarão, 31º53'07"S 56º36'04"W, Pedras Altas, 4 Feb 2006, E. Krause Lanés. MCP 40758, 4, 51.4-64.6 mm SL, tributary of arroio das Lavras, rio Camaquã drainage, Lavras do Sul, 30º50'02"S 53º53'52"W, 31 Jul 2007, T. P. Carvalho, A. R. Cardoso & J. M. Wingert. MCP 38352, 1, 59.4 mm SL, arroio Lageado tributary of arroio Arambaré, Pedro Osório, 31º51'51"S 52º49'24"W, 22 May 2005, R. E. Reis, P. C. Lehmann & E. H. L. Pereira. MCP 47412, 1, 63.5 mm SL, arroio da Gringa, *ca*. 12 km N from Dona Francisca dam, Agudo, 29º23'16"S 53º13'26"W, 23 Aug 1998, R. E. Reis, J. F. P. da Silva & V. A. Bertaco. **Rio Tramandaí system.** MCP 21119, 1, 84.2 mm SL, lagoa Fortaleza, Cidreira, 30º09'02"S 50º14'39"W, 20 Jul 1998, V. A. Bertaco & D. Gerlain. **Rio Uruguay drainage.** MCP 9493, 18 (8, 43.8-58.0 mm SL, 1 c&s 55.2 mm SL), stream on the road Cacequi-São Francisco de Assis, Vila Itapevi, 29º53'00"S 54º49'00"W, 14 Sep 1983, C. A. S. Lucena, L. R. Malabarba & R. E. Reis. MCP 47410, 1, 69.6 mm SL, arroio Canoin on the road Pirapó-São Nicolau, *ca.* 28º08'S 55º14'W, 2 Nov 1998, C. A. S. Lucena, A. Bergmann, E. H. L. Pereira. MCP 12368, 1, 71.8 mm SL, rio Canoas, on the road Anita Garibaldi-Abdon Batista, *ca.* 27º39'S 51º05'W, 8 Sep 1988, E. H. L. Pereira, M. Vargas, A. Bergmann & P. Azevedo. MCP 13117, 2, 67.0-70.0 mm SL, rio Canoas, on the road BR-282, Vargem - São José do Cerrito, *ca.* 27º33'S 50º53'W, 31 Mar 1989, L. A. Bergmann, P. Azevedo and M. Vargas. MCP 18558, 3, 64.5-66.6 mm SL, rio Dourado between Três Barras and Mariano Moro, 27º22'S 52º14'W, 21 Sep 1995, E. Filho, V. Schulz, P. Iaczinski & S. Meurer. MCP 47402, 13, 55.9-74.3 mm SL, arroio Capivari, on the road BR-453, rio Jaguari drainage, 29º21'10"S 54º28'32"W, 11 May 2001, C. A. S. Lucena, J. F. P. da Silva, E. H. L. Pereira & V. A. Bertaco. MCP 47403, 1, 77.0 mm SL, rio Uruguay near mouth of the rio Ligeiro, Marcelino Ramos, 27º31'28"S 51º50'15"W, 14 Nov 1996, E. H. L. Pereira, J. F. P. da Silva & R. E. Reis. MCP 27605, 4 (3, 43.3-48.0 mm SL), arroio Caraí-Passo, on the road São Francisco de Assis - Manuel Viana, rio Ibicuí drainage, 29º31'03"S 55º10'49"W, 12 May 2001, C. A. S. Lucena, V. A. Bertaco, E. H. L. Pereira & J. F. P. da Silva. MCP 47406, 1, 51.4 mm SL, tributary of the rio Quaraí, on the road Quaraí to Estação Férrea Baltazar Brum, *ca*. 2 km N from Quaraí, 30º21'52"S 56º23'26"W, 25 Apr 2004, R. E. Reis, A. Bergmann & P. Azevedo. MCP 47405, 3, 42.0-47.2- mm SL, river on the road Quaraí to Estação Férrea Baltazar Brum, *ca*. 20 km NE from Quaraí, 30º14'38"S 56º18'23"W, 24 Apr 2004, R. E. Reis, A. R. Cardoso, F. R. V. Ribeiro & M. Abreu. MCP 47408, 1, 43.4 mm SL, rio Garupá on the road Uruguaiana-Quaraí, border Uruguaiana-Quaraí, 30º07'24"S 56º25'29"W, 22 Jul 1986, R. E. Reis, A. R. Cardoso, F. R. V. Ribeiro & M. Abreu. MCP 47518, 2, 41.7-46.0 mm SL, 1 c&s, 42.6 mm SL, rio Quaraí-Mirim on the road Uruguaiana/Quaraí, Quaraí, 30º15'29"S 56º30'37"W, 30 Sep 1996, J. F. P. da Silva, W. Santos, E. S. Vidal & V. A. Bertaco.

Diagnosis. *Astyanax dissensus* differs from all congeners inhabiting the rio Uruguay basin, laguna dos Patos and rio Tramandaí systems, except *A. ojiara*, in having one heptacuspid tooth on maxillary (*vs*. tri- to pentacuspid teeth). From *A. ojiara* it differs by the head length (22.7-27.3% *vs*. 27.3-29.5% of SL) and by the presence of hooks on anal fin on males (*vs*. all fins with hooks). The following combination of characters distinguish *A. dissensus* from all others species of the genus (including species complex *A. bimaculatus* and *A. scabripinnis*): the presence of two humeral spots, the first spot vertically elongate, a conspicuous caudal spot, 35-39 perforated lateral line scales, 6-7 scale rows between dorsal-fin origin and lateral line, 22-28 branched anal-fin rays, predorsal region scaled, one heptacuspid maxillary tooth, body depth (37.2-44.2% of SL), and head length (22.7-27.3% of SL).

Description. Morphometric data summarized in Table 1. Body compressed and deep, with greatest body depth anterior to dorsal-fin origin. Dorsal profile of head straight or slightly concave from region above the eye to supraoccipital spine. Dorsal body profile convex from tip of supraocciptal spine to base of last dorsal-fin ray; straight from latter point to adipose fin origin. Ventral profile of body convex from mandibular symphysis to pelvic-fin origin, nearly straight to anal-fin origin, and posterodorsally slanted along anal-fin base. Caudal peduncle deep, nearly straight to slightly concave in the dorsal and ventral margins.

Snout rounded from margin of upper lip to vertical through anterior nostrils. Head somewhat pointed anteriorly in lateral profile. Mouth terminal, jaw isognathous. Maxilla extending to vertical through anterior margin of orbit. Maxilla slightly widened anteroposteriorly.

Two tooth rows in premaxilla; outer row with 2(2), 3(57)*, 4(14), or 5(2) pentacuspid teeth, central cusp longer; inner row with five teeth, gradually decreasing in length from the first to fifth with seven to nine cusps, except the first teeth with asymmetric five cups ; central cusp twice as long and broad as others cusps. Maxilla with one tooth bearing seven cusps (in some specimens one of two lateral cusp may be worn. In this case, taking six cusps); central cusp slightly broader than others. Dentary with nine to ten teeth. Five or six anteriormost dentary teeth decreasing gradually, first four or five hexacuspid, fifth or sixth tetracuspid teeth; remaining three or four, smaller, uni- to tricuspid (Fig. 2).

Dorsal-fin rays ii,8(5), or 9(73)*; first unbranched ray approximately half length of second ray. Distal margin of dorsal-fin nearly straight to somewhat convex. Dorsal-fin origin approximately at middle of SL. Origin of the adipose fin at vertical through fifth or sixth last rays of the anal-fin. Anal-fin rays v (2 c&s), 22(6), 23(20), 24(18), 25(21)*, 26(4), 27(7), or 28(2). First unbranched ray normally only apparent in c&s specimens. Anal-fin profile smoothly concave. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Pectoral-fin rays i,11*(25), 12(21), or 13(3). Pectoral-fin tip not reaching pelvic-fin insertion; reaching the pelvic-fin origin in small specimens (*ca*. 41.0 mm SL). Pelvic-fin rays i,6(4), or 7(75)*. Pelvic-fin origin slightly anterior to vertical through dorsal-fin origin. Pelvic-fin tip extend beyond the genital opening but not reach the anal-fin origin. Caudal fin forked, lobes similar in size, rounded, i,17,i principal rays. Dorsal procurrent rays 11(1) and ventral procurrent rays 8(1).

Lateral line complete with 35(2), 36(22), 37(40)*, 38(8), or 39(4) scales. Scale rows between dorsal-fin origin and lateral line 6(62)*, or 7(17); scale rows between lateral line and pelvic-

Table 1. Morphometric data for new species of *Astyanax*, *A. dissensus* (n = 75), *A. procerus* (n = 30), and *A. xiru* (n = 36), based on type series indicated in the text. The range included the holotype (H). SD = standard deviation.

	A. dissensus				*A. procerus*				*A. xiru*			
	H	Range	Mean	SD	H	Range	Mean	SD	H	Range	Mean	SD
Standard length (mm)	65.1	39.2-77.0	57.9	-	101.8	56.4-118.5	87.0	-	95.7	52.9-109.3	83.9	-
Percents of Standard length												
Predorsal distance	51.4	49.6-54.9	52.4	1.1	52.0	50.2-56.2	53.1	1.3	52.8	49.7-54.8	52.4	1.1
Prepelvic distance	44.8	44.6-51.1	47.8	1.6	50.2	47.5-52.6	50.1	1.2	49.2	46.4-51.4	49.1	1.2
Prepectoral distance	24.7	24.2-29.1	26.4	0.9	24.7	23.4-27.2	25.1	1.0	26.4	23.7-27.3	25.5	0.8
Preanal distance	63.5	60.0-69.0	64.7	2.0	69.0	63.7-71.3	67.9	1.6	68.2	63.5-69.4	66.2	1.5
Depth at dorsal-fin origin	39.7	37.2-44.6	40.4	1.6	41.3	38.3-46.0	41.3	1.9	34.6	32.5-37.5	35.0	1.2
Caudal peduncle depth	11.8	9.6-12.6	11.3	0.6	12.0	11.2-13.3	12.4	0.5	11.7	10.8-12.7	11.8	0.4
Caudal peduncle length	13.3	10.4-14.8	12.9	1.0	14.1	13.1-16.2	14.6	0.8	14.2	13.3-15.9	14.8	0.7
Anal-fin base length	32.2	24.8-33.5	30.6	1.9	25.6	23.4-29.8	26.5	1.5	24.7	23.3-27.4	25.1	1.0
Dorsal-fin length	27.1	24.6-31.9	28.0	1.2	25.4	24.1-28.7	26.0	1.1	22.5	21.1-25.4	23.1	1.1
Pelvic-fin length	17.3	15.8-20.2	17.4	0.8	16.7	16.1-18.7	17.2	0.6	15.6	13.6-171.	15.3	0.7
Pectoral-fin length	20.7	19.6-25.7	22.1	0.9	22.3	21.8-24.1	22.9	0.7	20.6	18.9-23.1	20.9	0.9
Head length	23.8	22.7-27.3	25.0	1.0	25.2	23.8-26.6	25.0	0.7	26.6	24.2-27.3	25.7	0.7
Percents of Head length												
Snout length	22.5	19.2-26.9	23.0	1.8	24.5	19.9-24.5	22.5	1.0	21.9	19.0-24.0	22.3	1.0
Upper jaw length	35.4	33.6-46.3	38.2	2.2	42.8	38.3-46.3	42.0	1.9	41.8	39.3-46.2	42.0	1.2
Maxillary lenght	19.3	19.1-27.5	22.7	1.8	23.7	20.3-25.0	22.9	1.1	22.3	22.2-28.2	24.9	1.4
Orbital diameter	34.8	32.7-45.1	39.4	2.6	35.0	34.8-41.5	37.1	1.8	32.9	32.1-36.6	33.7	1.1
Interorbital width	36.1	31.1-43.0	34.8	2.0	33.8	28.5-34.9	32.5	1.7	31.7	29.8-34.2	31.7	1.1

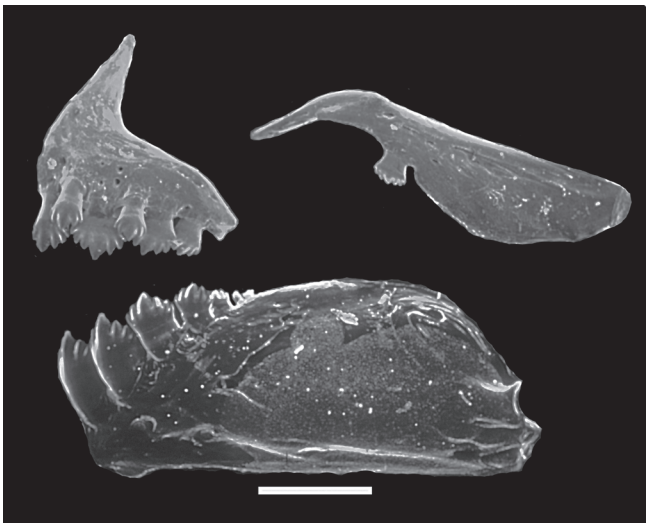

Fig. 2. *Astyanax dissensus*, new species, MCP 19561, 42.6 mm SL, paratype, upper and lower jaws teeth, left side, lateral view. Scale bar = 1 mm.

fin origin 4(1), 5(62), or 6(16). Predorsal scales 9(5), 10(33), 11(27)*, 12 (4), or 13(2) arranged in regular series. Scale rows around caudal peduncle 14(77)*. Scale sheath along anal-fin base 8*-15 scales, in single series, covering base of anteriormost rays.

Precaudal vertebrae 15(2) or 16(1); caudal vertebrae 20(3); total vertebrae 35(2) or 36(1). Supraneurals 5(3). Gill-rakers upper branch 6 (40)*, 7(35), or 8(3); lower branch 10(7), 11(37), 12(28)*, or 13(6); total number 16(2), 17(31), 18(19)*, 19(18), 20(4), or 21(2).

Color in alcohol. Dorsal and dorsolateral portions of head and body dark brown. Body with black, midlateral stripe (silvery in some specimens probably due to fixation) placed on one to one and half series of scales extending from the second humeral spot to caudal-fin base; narrowing between the second humeral spot and opercle (region between spots pale in some specimens). Midlateral body stripe slightly expanded dorsally and ventrally to caudal-fin base, forming small caudal spot; dark pigmentation present on middle caudal-fin rays. Two humeral spots. Anterior one, conspicuous, vertically elongate with superior portion somewhat wider. Second humeral spot large, occasionally faint, not ventrally surpassing lateral line. Fins with a few dispersed dark chromatophores (Fig. 1).

Sexual dimorphism. Males with fine and delicate, bony hooks on pelvic-fin and anal-fin rays. One paired bony hook per lepidotrichia in last unbranched ray and from the first to eleventh to twelfth anal-fin branched rays; the first seven or eight on upper third portion of rays; the remaining restricted to distal portions of rays. Hooks on the pelvic-fin are distributed in first three or four branched rays. Gill glands (Burns & Weitzman, 1996) were not found on first gill arch in either males or females.

Distribution. *Astyanax dissensus* is known from the laguna dos Patos system and rio Uruguay drainage (Fig. 3). One specimen was captured from coastal lagoon of rio Tramandaí system (MCP 21119). *Astyanax dissensus* appears to be rare in the rio Tramandaí system because although the sampling efforts in the region it is not mentioned in the Malabarba *et al*. (2013).

Etymology. The specific epithet *dissensus* from Latin, disagreement, in reference to the larger maxillary heptacuspid tooth peculiar to the species and unusual in *Astyanax* species.

Astyanax procerus Lucena, Castro & Bertaco, new species
Figs. 4-5

Astyanax sp. 1. -Becker *et al*., 2013: 82 (listed).

Holotype. MCP 47002, 101.8 mm SL, Brazil, Rio Grande do Sul State, Nicolau Vergueiro, arroio Quebra Dentes, 28º36'09"S 52º27'03"W, 19 Jan 1999, R. E. Reis, J. F. P. da Silva & E. H. L. Pereira.

Paratypes. Brazil, Rio Grande do Sul State, **laguna dos Patos system.** MCN 19584, 2, 54.3-63.9 mm SL, MCP 33427, 39 (2, 56.4-68.4 mm SL, 1, 75.0 mm SL c&s), UFRGS 17098, 2, 48.8-67.1 mm SL, rio das Antas, upstream of Cachoeirão, Nova Roma do Sul, 29º00'40"S 51º22'22"W, 1 Oct 2002, J. Latini, J. R. Gonçalves & V. Capatti. MCP 21258, 8, 1, 84.0 mm SL, tissue,

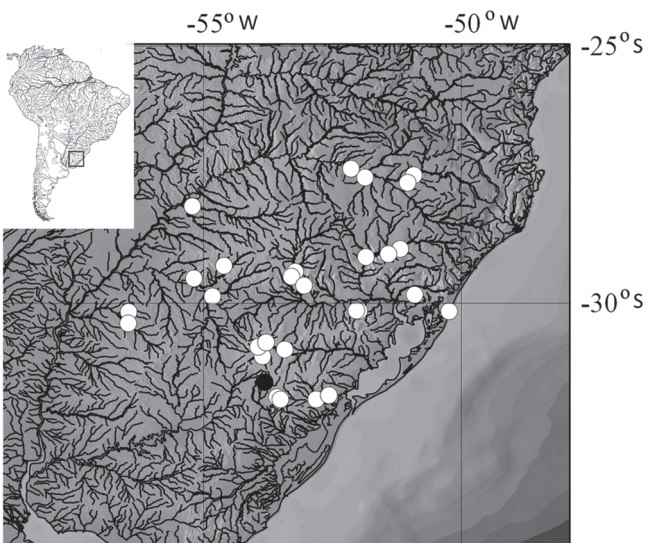

Fig. 3. Map of southern Brazil and Uruguay, showing the distribution of the material examined of *Astyanax dissensus*. Some symbols represent more than on lot or locality. Black circle = type locality.

Fig. 4. *Astyanax procerus*, new species, MCP 47002, 101.8 mm SL, holotype, arroio Quebra Dentes at Quebra Dentes, Nicolau Vergueiro, Rio Grande do Sul, Brazil.

box I-28 (3, 83.6-90.7 mm SL), arroio da Gringa *ca*. 12 km North of Dona Francisca dam, Agudo, 29º23'16"S 53º13'23"W, 23 Aug 1998, R. E. Reis, J. F. P. da Silva & V. A. Bertaco. MCP 21457, 4 (2, 88.9-92.6 mm SL), arroio Trombudo, Dona Francisca, 29º31'30"S 53º20'45"W, 10 Oct 1998, R. E. Reis, J. F. P. da Silva & E. H. L. Pereira. MCP 21476, 4 (3, 87.1-87.9 mm SL), rio Ferreira between Pinhal Grande and Itaúba, Pinhal Grande, 29º16'37"S 53º14'53"W, 11 Oct 1998, R. E. Reis, J. F. P. da Silva & E. H. L. Pereira. MCP 25513, 2, 88.9-100.0 mm SL, 1, 78.0 mm SL c&s, arroio Quebra Dentes, Nicolau Vergueiro, 28º36'09"S 52º27'03"W, 19 Jan 1999, R. E. Reis, J. F. P. da Silva & E. H. L. Pereira. MCP 33592, 1, 91.4 mm SL, 1 c&s, 65.0 mm SL, Quaresma, near to rio das Antas, Antônio Prado, 28º52'46"S 51º19'12"W, 2003, J. Latini, J. R. Gonçalves & V. Capatti. MCP 33607, 2, 89.8-118.5 mm SL, rio das Antas, near mouth of rio Carreiro, Santa Barbara, 29º05'29"S 51º42'42"W, 6 Nov 2002, J. Latini, J. R. Gonçalves & V. Capatti. MCP 37787, 2, 56.9-58.5 mm SL, MCP 37788, 2, 81.2-92.1 mm SL, rio das Antas drainage, Monte Claro dam, Bento Gonçalves, 29º01'08"S 51º28'28"W, Aug 2004, J. Latini, J. R. Gonçalves & V. Capatti. MCP 37791, 3, 67.6-72.6 mm SL, rio das Antas, near mouth of rio da Prata, Nova Roma do Sul, 29º04'01"S 51º22'48"W, 14 Feb 2003, A. R. Cardoso & V. A. Bertaco. MCP 37792, 2 (1, 92.9 mm SL), downstream of Cachoeirão, Caninana rapids, Nova Roma do Sul, 29º04'01"S 51º22'48"W, Aug 2004, J. Latini, J. R. Gonçalves & V. Capatti. MCP 43063, 1, 101.2 mm SL, rio das Antas, Castro Alves dam, Nova Roma do Sul, 28º57'01"S 51º14'53''W, Jan 2008, J. Latini, J. R. Gonçalves & V. Capatti. MCP 43108, 1, 109.0 mm SL, rio das Antas, Castro Alves dam, Nova Roma do Sul, 28º57'01"S 51º14'53''W, Apr 2008, J. Latini, J. R. Gonçalves & V. Capatti. MCP 43517, 2, 95.4-101.2 mm SL, rio das Antas, Castro Alves dam, Nova Roma do Sul, 28º57'01"S 51º14'53"W, May 2008, J. Latini, J. R. Gonçalves & V. Capatti. MCP 47390, 3 (2, 96.0-98.3 mm SL), rio Guaporé at Paraíso, Guaporé, *ca*. 28º50'S 51º53"W, 9 Jul 1999, P. Azevedo, W. Taborda & E. Borsato.

Diagnosis. *Astyanax procerus* differs from all congeners inhabiting the rio Uruguay basin, laguna dos Patos and rio Tramandaí systems by the first humeral spot vertically elongate with upper portion wider portion narrow and curved, with a pronounced constriction at the junction of both portions (*vs.* present of oval shape spot with two brown vertical bars in humeral region in *A. jacuhiensis*, oval shape in *A. laticeps* and forming a uniform wedge in *A. eigenmanniorum* and *A. henseli*), 18-23 branched anal-fin rays (*vs*. 18 or less in *A. brachypterygium* and *A. cremnobates*, 23 or more in *A. aramburui*, *A. paris*, *A. saguazu*, and *A. stenohalinus*), two humeral spots (*vs*. one in *A. eigenmanniorum*, *A.* sp. aff. *fasciatus*, *A. jacuhiensis*, and *A. laticeps*), by the presence of one maxillary teeth (*vs*. 2-5 in *A. henseli*), and by the body depth, 38.3-46.0% (*vs*. smaller than 38% of SL in *A. brachypterygium*, *A. cremnobates*, *A. obscurus*, and *A. xiru* new species), maxillary teeth tri- to pentacuspid (*vs*. hexa- to heptacuspid in *A. dissensus* new species and *A. ojiara*). Most similar to *A. xiru* in color pattern, differing by the pelvic-fin length (16.1-18.7% *vs*. 13.6-17.1% of SL), dorsal-fin length (24.1-28.7% *vs*. 21.1-25.4% of SL), absence of bony hooks on the anal and pelvic fins of males (*vs*. presence). The following combination of characters distinguish *A. xiru* from all others species of the genus (including the species complex *A. bimaculatus* and *A. scabripinnis*): the presence of two conspicuous humeral spots (first humeral spot vertically elongate with upper portion wider portion narrow and

curved, with a pronounced constriction at the junction of both portions), a conspicuous wide lateral band, 18-23 branched anal-fin rays, 20-23 gill rakers on first branchial arch, 37-40 perforated lateral line scales, 5 scale rows between lateral line and anal-fin origin, outer row of premaxilla with pentacuspid teeth, inner premaxilla row with heptacuspid teeth, one maxillary tooth tri- to pentacuspid, the absence of hooks on fins of males, a conspicuous caudal spot, body depth 38.3-46.0% of SL, head length 23.8-26.6% of SL, anal-fin base length 23.4-29.8% of SL, pectoral-fin length 21.8-24.1% of SL, and interorbital width 28.5-34.9% of HL.

Description. Morphometric data summarized in Table 1. Body compressed and deep, with greatest body depth anterior to dorsal-fin origin. Dorsal profile of head straight or slightly convex from posterior nostril to tip of supraoccipital spine. Dorsal body profile convex from tip of supraoccipital spine to base of last dorsal-fin ray; straight from latter point to adipose fin origin. Ventral profile of body convex from vertical through posterior nostril to pelvic-fin origin, nearly straight to anal-fin origin, and posterodorsally slanted along anal-fin base. Caudal peduncle elongate, nearly straight to slightly concave in the dorsal and ventral margins.

Snout rounded from margin of upper lip to vertical through anterior nostrils. Head somewhat pointed anteriorly in lateral profile. Mouth terminal, jaw isognathous, Maxilla extending posteriorly to vertical through anterior margin of orbit, slightly curved.

Two tooth rows in premaxilla; outer row with 4(4), 5(16)*, or 6(9) pentacuspid teeth, central cusp longer; inner row with five teeth, gradually decreasing in length from the first to fourth, last distinctly smaller, with six to seven cusps; except the first teeth with asymmetric five cups and the last with five or six cusps, central cusp twice as long and broad as others cusps. Maxilla with one tooth bearing four or five cusps, central cusp longer. Dentary with nine to ten teeth. Five anteriormost dentary teeth decreasing gradually, penta- to hexacuspid; remaining four or five smaller, tetra-, tricuspid or, rarely, unicuspid. Central cusp in all teeth two to three times as long and broad as other cusps. All cusp tips slightly curved posteriorly towards inside mouth (Fig. 5).

Dorsal-fin rays ii,8(1) or 9(29)*; first unbranched ray approximately half length of second ray. Distal margin of dorsal-fin nearly straight to somewhat convex. Dorsal-fin origin approximately at middle of SL. Adipose fin before to vertical through last anal-fin ray insertion. Anal-fin rays iii-v, 19(3), 20(8), 21(8), 22(8)*, or 23(3). First unbranched ray normally only apparent in c&s specimens. Anal-fin profile smoothly concave. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Pectoral-fin rays i,11(5), 12(15)*, or 13(5). Pectoral-fin tip reaching one scales before vertical through pelvic-fin insertion; in young specimens (*ca*. 50.0 mm SL) reaching the vertical through pelvic-fin insertion. Pelvic-fin rays i,6(1) or 7(29). Pelvic-fin origin slightly anterior to vertical through dorsal-fin origin. Pelvic-fin tip extend beyond the genital opening but not reach the anal-fin origin. Caudal fin forked, lobes similar in size, rounded, i,17,i (30) principal rays. Dorsal procurrent rays 12(2) and ventral procurrent rays 9(1), or 10(1).

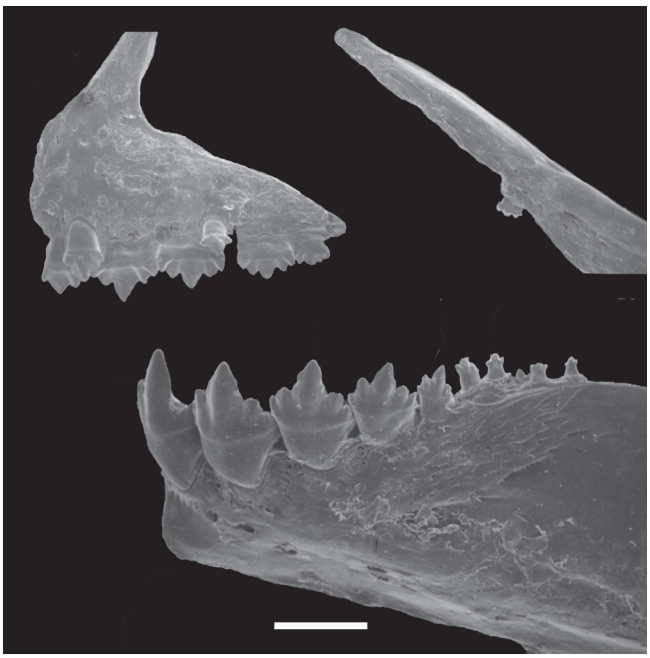

Fig. 5. *Astyanax procerus*, new species, MCP 25513, 78.0 mm SL, paratype, upper and lower jaws teeth, left side, lateral view. Scale bar = 1 mm.

Lateral line complete with 37(7), 38(19)*, 39(8), or 40(2) scales. Scale rows between dorsal-fin origin and lateral line 6(20), or 7(9); scale rows between lateral line and pelvic-fin origin 4(5)*, or 5(25). Predorsal scales 11(15), 12(13)*, 13(1), or 14(1) arranged in regular series. Scale rows around caudal peduncle 14(11), 15(13), or 16(6). Axillary scale on pelvic-fin origin extends posteriorly covering 2-3 scales. Scale sheath along anal-fin base 10-13 scales, in single series, covering base of anteriormost rays.

Precaudal vertebrae 18(2), or 19(1); caudal vertebrae 18(1), or 19(2); total vertebrae 36(1), 37(1), or 38 (1). Supraneurals 5(1), or 6(2). Gill-rakers upper branch 7(3), 8(21), or 9(6); lower branch 13(12)*, 14(19), or 15(3); total number 20(3), 21(9)*, 22(10), or 23(8).

Color in alcohol. Dorsal and dorsolateral portions of head and body dark brown. Dark chromatophores scattered on lateral portion of head, more densely concentrated on snout and anterior border of eye. Dorsal portion of body densely pigmented. Body with black, midlateral stripe extending from the second humeral spot to caudal-fin base; dark pigmentation present on middle caudal-fin rays. Midlateral body stripe slightly expanded dorsally and ventrally to caudal-fin base. Two humeral

spots. Anterior one, conspicuous, vertically elongate with superior portion wider, located over fourth to fifth vertical series of scales, extending over two to three horizontal series of scales above lateral line; inferior portion of spot narrow and curved, sometimes with constriction at the junction with the upper portion, (one to two scales pigmented), extending over one to two horizontal series of scales below lateral line. Second humeral spot large, not ventrally surpassing lateral line, extending over three horizontal series and two to three vertical series of scales. Region between spots pale. Fins with dispersed dark chromatophores (Fig. 4).

Sexual dimorphism. Secondary sexual characters were not found on examined specimens. Testes were observed in 15 specimens (MCP 37791, 72.6 mm SL, male, MCP 33592, 91.4 mm SL, female, MCP 33607, 118.5 mm SL, female and 89.8 mm SL, male. MCP 43517, 101.2 mm SL, female and 95.4 2 mm SL, male, MCP 21457, 92.6 mm SL, female and 88.9 mm SL, male, MCP 25513, 88.9 mm SL, female and 100.0 mm SL, male; MCP 21476, 87.1 mm SL, female, 87.5 mm SL, male, and, 87.9 mm SL male. MCP 37787, 58.5 mm SL, male and 56.9 mm SL, male). Not all males were mature. Gill glands (Burns & Weitzman, 1996) were not found on first gill arch in all specimens.

Distribution. *Astyanax procerus* is known from the upper and middle rio Taquari-Antas and rio Jacuí, laguna dos Patos system, Rio Grande do Sul, Brazil (Fig. 6).

Etymology. The specific epithet *procerus* from Greek, means tall, in reference the high body depth of the species. An adjective in apposition.

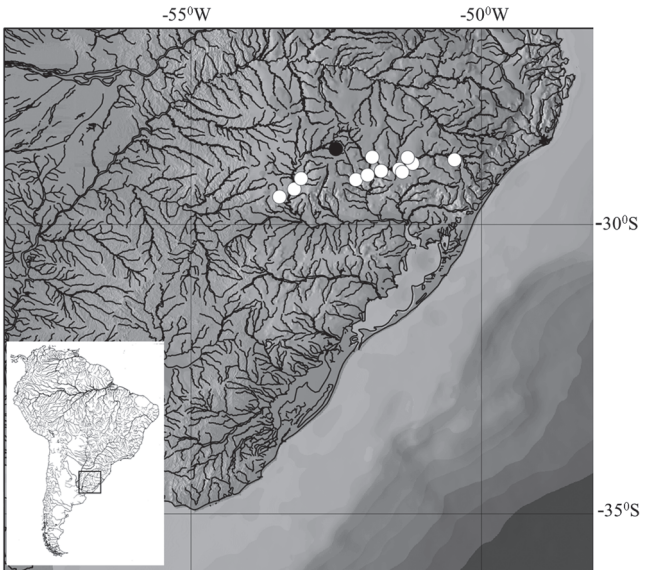

Fig. 6. Map of southern Brazil and Uruguay, showing the distribution of the material examined of *Astyanax procerus*. Some symbols represent more than on lot or locality. Black circle = type locality.

Astyanax xiru Lucena, Castro & Bertaco, new species
Figs. 7-8

Astyanax obscurus Bertaco & Lucena, 2010: 11 (in part).

Holotype. MCP 19986, 95.7 mm SL, Brazil, Rio Grande do Sul, Sapiranga, rio Feitoria, rio Caí drainage, 29º38'10"S 51º00'28"W, May 1996, D. Jacobus, L. F. B. Moreira & G. von Mülhen.

Paratypes. Brazil, Rio Grande do Sul State, laguna dos Patos system. MCN 19583, 2, 78.7-84.3 mm SL, MCP 20008, 10 (5, 78.5-89.2 mm SL), UFRGS 17099, 2, 80.0-82.0 mm, arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 15 Mar 1997, D. Jacobus & A. Fialho. MCP 18699, 1, 93.5 mm SL, rio Saltinho, Vacaria, *ca*. 28º30'S 50º56'W, 24 Sep 1995, C. Silveira & P. Reiman. MCP 19950, 3, 85.0-98.2 mm SL, arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 10 Apr 1996, D. Jacobus & A. Fialho. MCP 19962, 3, 52.9-95.7 mm SL, arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 18 May 1996, D. Jacobus, L. Moreira & G. von Mülhen. MCP 19964, 1, 97.4 mm SL, arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 23 Nov 1996, D. Jacobus, A. Fialho & L. Moreira. MCP 19978, 9 (4, 81.5-99.3 mm SL), arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 9 Feb 1997, D. Jacobus, A. Jacobus & A. Fialho. MCP 20005, 1, 91.0 mm SL, arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 14 Sep 1996, D. Jacobus & A. Fialho. MCP 20016, 3, 84.3-109.3 mm SL, arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 17 Aug 1996, D. Jacobus, L. Moreira & G. von Mülhen. MCP 20046, 5 (3, 70.5-80.3 mm SL), arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 18 Dec 1996, D. Jacobus & A. Fialho. MCP 21327, 1, 70.5 mm SL, arroio Feitoria, Sapiranga, *ca*. 29º34'S 51º00'W, 1997, D. Jacobus & A. Fialho. MCP 21730, 12 (2, 58.1-70.6 mm SL c&s), stream between Dois Irmãos and Morro Reuter, at Travesso, *ca*. 29º33'S 51º06'W, 4 Sep 1991, Ictiology team UFRGS (cited as *A. obscurus* by Bertaco & Lucena, 2010). MCP 32354, 5, 26.7-70.1 mm SL, rio Tainhas border of São Francisco de Paula and Jaquirana, 28º52'06"S 50º27'33"W, 14 Feb 2003, V. A. Bertaco & A. R. Cardoso. MCP 33580, 4, 70.5-86.9 mm SL (1, 70.5 mm SL c&s), rio do Cachaço, near mouth of rio das Antas, Nova Roma do Sul, 29º02'44"S 51º26'37"W, 2003, J. Latini, J. R. Gonçalves & V. Capatti. MCP 33666, 5 (3, 72.5-87.2 mm SL), rio São Roque, near mouth of rio das Antas, 29º03'48"S 51º25'37"W, 2003, J. Latini, J. R. Gonçalves & V. Capatti. MCP 43547, 1, 83.7 mm SL, córrego Inferno, Antônio Prado, 28º52'34"S 51º18'59"W, Jul 2008, J. Latini, J. R. Gonçalves & V. Capatti. MCP 47387, 1, 80.3 mm SL, Quaresma, near rio das Antas, Antônio Prado, 28º52'46"S 51º19'12"W, 2003, J. Latini, J. R. Gonçalves & V. Capatti.

Additional material (non-types). Brazil, rio Uruguay drainage, Rio Grande do Sul State. MCP 10855 (2, 90.2-91.1 mm SL), river on the road Coimbra to Santo Ângelo, Santo Ângelo, *ca*. 28º24'S 54º18'W. MCP 37065, 1, 56.4 mm SL, arroio Limoeiro, tributary of rio Ijuí, 16 de Novembro, 28º11'41"S 55º01'14"W. MCP 41490, 6 (2, 67.5-81.9 mm SL), rio do Ouro, rio Forquilha drainage, Paim Filho, 27º41'06"S 51º42'10"W. **Santa Catarina State.** MCP 20874, 65 (7, 67.0-80.1 mm SL), arroio Lageado Grande, *ca*. 3 km of Linha Santana, on the road Santa Helena/Descanso, 26º53'35"S 53º36'04"W. MCP 40007, 2, 55.8-88.8 mm SL, riacho in the bridge at Nova Ibiaçá, Serra Alta, 26º51'42"S 53º00'09"W. MCP 40119 (4, 73.6-89.8 mm

Fig. 7. *Astyanax xiru*, new species, MCP 19986, 95.7 mm SL, holotype, rio Feitoria, rio Jacuí drainage, Sapiranga, Rio Grande do Sul, Brazil.

SL), rio Saudade, bridge in Modelo to BR-282, 26º46'10"S 53º02'43"W. MCP 40124, 45 (4, 65.7-99.2 mm SL), rio Burro Branco, border Serra Alta and Sul Brasil, 26º41'12"S 52º49'02"W.

Diagnosis. *Astyanax xiru* is distinguished from its congeners from the rio Uruguay basin and laguna dos Patos and rio Tramandaí systems by the presence of two humeral spots and the shape of the first humeral spot: upper portion horizontally elongate and lower portion vertically narrow (*vs*. one spot in *A. eigenmanniorum*, *A.* sp. aff. *fasciatus*, *A. jacuhiensis*, and *A. laticeps* and ovale shape in last two species); by the presence of one maxillary tooth (*vs*. 2-5 in *A. henseli* and 3-4 in *A. paris*), by the maxillary tooth tri- to pentacuspid (*vs*. heptacuspid in *A. ojiara* and *A. dissensus* new species), by the number of branched anal-fin rays (18-22 *vs*. 25-30 in *A. saguazu* and *A. stenohalinus*, 23-29 in *A. aramburui*, 18 or less in *A. brachypterygium* and *A. cremnobates*), by the body depth (32.3-37.5% *vs*. 38.3-46.0% of SL in *A. procerus* new species), by the presence of a very few small hooks on anal and pelvic-fin of males (*vs*. absence in *A. obscurus*). Most similar to *A. procerus* in color pattern, differing by the pelvic-fin length (13.6-17.1% *vs*. 16.1-18.7% of SL), dorsal-fin length (21.1-25.4% *vs*. 24.1-28.7% of SL), males with bony hooks on the anal and pelvic fins (*vs*. absence). The following combination of characters distinguish *A. xiru* from all others species of the genus (including the species complex *A. bimaculatus* and *A. scabripinnis*): the presence of two conspicuous humeral spots (the first humeral spot vertically elongate with upper portion wider and lower portion narrow), the presence of a conspicuous wide lateral band, 18-22 branched anal-fin rays, 19-24 gill rakers on first branchial arch, 37-40 perforated lateral line scales, 4-5 scale row between lateral line and pelvic-fin origin, outer row of premaxilla with pentacuspid teeth, inner premaxilla row with heptacuspid teeth, one maxillary teeth tri- to pentacuspid, very few small hooks on anal and pelvic fin of males, conspicuous caudal spot, head length 24.2-27.3% of SL, body depth 32.5-37.5% of SL, interorbital width 29.8-34.2% of HL, orbital diameter 32.1-36.6% of HL, head length 24.2-27.3% of SL, and anal-fin base length 23.3-27.4% of SL.

Description. Morphometric data summarized in Table 1. Body compressed and elongate, with greatest body depth anterior to dorsal-fin origin. Dorsal profile of head straight or slightly convex from posterior nostril to tip of supraoccipital spine. Dorsal body profile convex from tip of supraoccipital spine to base of last dorsal-fin ray; straight from latter point to adipose fin origin. Ventral profile of body slightly convex from vertical through posterior nostril to pelvic-fin origin, nearly straight to anal-fin origin, and posterodorsally slanted along anal-fin base. Caudal peduncle elongate, nearly straight to slightly concave in the dorsal and ventral margins.

Snout rounded from margin of upper lip to vertical through anterior nostrils. Mouth terminal, jaws isognathous. Maxilla extending posteriorly to vertical through anterior margin of orbit.

Two tooth rows in premaxilla; outer row with 4(8)*, 5(5) or distinct combinations considering left/right sides, 4/5; 6/4 or 6/5 pentacuspid teeth, central cusp longer; inner row with five teeth, gradually decreasing in length from the first to fourth, last distinctly smaller, with seven cusps; except the first tooth with asymmetric five cups (3+1+1) and the last with five or six cusps; central cusp twice as long and broad as others cusps. Maxilla with one tooth, tri- to pentacuspid, with central cusp longer. Dentary with nine to ten teeth. Five anteriormost dentary teeth decreasing gradually, hexa- to heptacuspid; remaining four or five smaller, tetra- or pentacuspid; last two unicuspid. Central cusp in all teeth two

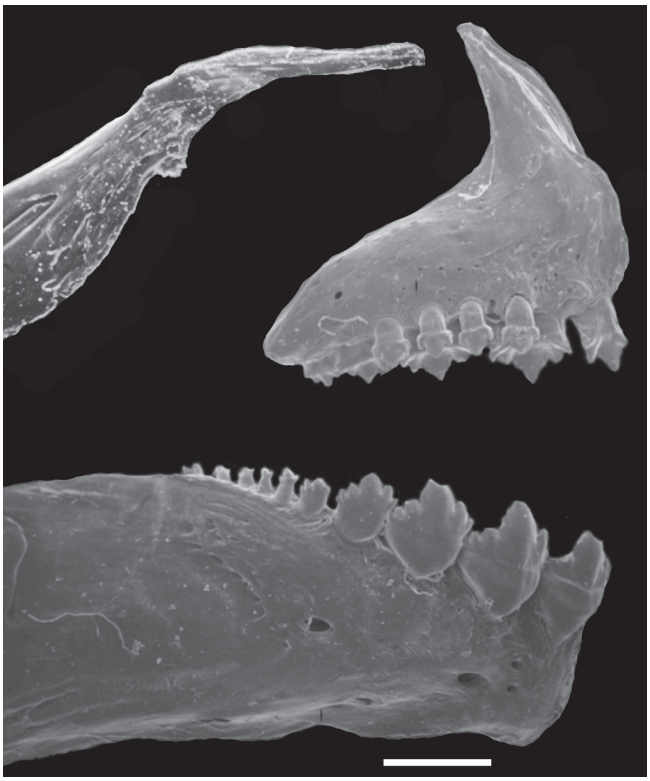

Fig. 8. *Astyanax xiru*, new species, MCP 33580, 70.5 mm SL, paratype, upper and lower jaws teeth, left side, lateral view. Scale bar = 1 mm.

to three times as long and broad as other cusps. All cusp tips slightly curved posteriorly towards inside mouth (Fig. 8).

Dorsal-fin rays ii,9(36); first unbranched ray approximately one third to half length of second ray. Distal margin of dorsal-fin nearly straight to somewhat convex. Dorsal-fin origin approximately at middle of SL. Adipose fin slightly anterior at vertical through last anal-fin ray insertion. Anal-fin rays iii-v, 18(1), 19(5), 20(16)*, 21(7), or 22 (5). First unbranched ray normally only apparent in c&s specimens. Anal-fin profile smoothly concave. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Pectoral-fin rays i,11(8)*, 12(20), or 13(6). Pectoral-fin tip reaching one or two scales before vertical through pelvic-fin insertion. Pelvic-fin rays i,7(34), or 8(2). Pelvic-fin origin slightly anterior to vertical through dorsal-fin origin. Pelvic-fin tip extend beyond the genital opening but not reach the anal-fin origin. Caudal fin forked, lobes similar in size, rounded, i,17,i principal rays. Dorsal procurrent rays 10-11, and ventral procurrent rays 8-10 (n = 2).

Lateral line complete with 37(7), 38(11), 39(16), or 40(1) scales. Scale rows between dorsal-fin origin and lateral line 6(21)*, or 7(14); scale rows between lateral line and pelvic-fin origin 4(9), or 5(26)*. Predorsal scales 11(12), 12(15), or 13(8) arranged in regular series. Scale rows around caudal peduncle 14(16)*, 15(12), or 16(7). Axillary scale on pelvic-fin origin extends posteriorly covering two scales. Scale sheath along anal-fin base 6-10 scales, in single series, covering base of anteriormost rays.

Precaudal vertebrae 18(1) or 19(2); caudal vertebrae 16(1), 18 (1), or 19(1); total vertebrae 35(1), 36(1), or 38(1). Supraneurals 5(2). Gill-rakers upper branch 7(8), 8(24)*, or 9(3), lower branch 11(1), 12(2), 13(18), or 14(14); total number 19(3), 20(6), 21(10), 22(15)*, or 23(1).

Color in alcohol. Dorsal and dorsolateral portions of head and body dark brown. Dark chromatophores scattered on lateral portion of head, more densely concentrated on snout and anterior border of eye. Dorsal portion of body densely pigmented in larger specimens. Body with black, midlateral stripe extending from the second humeral spot to caudal-fin base; dark pigmentation present on middle caudal-fin rays. Midlateral body stripe expanded dorsally and ventrally to caudal-fin base, forming small caudal spot. Two humeral spots. Anterior one, conspicuous, vertically elongate with superior portion wider, located over third to four vertical series of scales, extending over two to three horizontal series of scales above lateral line; inferior portion of spot narrow, sometimes with constriction at the junction with the upper portion (one to two scales pigmented), extending over one or two horizontal series of scales below lateral line. Second humeral spot large, evident, not ventrally surpassing lateral line, extending over three horizontal series and two to three vertical series of scales. Region between spots pale. Fins with dispersed dark chromatophores (Fig. 7).

Sexual dimorphism. Males with small, fine and delicate, bony hooks on the anal- and pelvic-fin rays. One bony hook per lepidotrichia, rarely one pair, from the first to seventh anal-fin branched rays; maximum seven hooks per ray. Hooks on the pelvic-fin are distributed in second to fourth branched rays. Gill glands (Burns & Weitzman, 1996) were not found macroscopically on first gill arch in either males or females.

Distribution. *Astyanax xiru* is known from the rio Jacuí drainage, laguna dos Patos system, and from the upper rio Uruguay drainage, Rio Grande do Sul, and Santa Catarina States (Fig. 9). Additional specimens listed did not differ from the population of the laguna dos Patos system but only specimens this system were included as paratypes in order to maintain type series from a single basin.

Etymology. The specific epithet *xiru*, from Tupi-Guarani, means an old wise Indian. Word used mainly in the treatment personal in the countryside of Rio Grande do Sul State.

Comments. *Astyanax xiru* has some characters that define *Astyanax scabripinnis* species complex *sensu* Bertaco & Lucena (2006). However, we decided not considering it as belonging to that complex by the presence of a relatively pointed snout, head less massive and higher body in the vertical through the dorsal-fin origin. This not precludes that the species is indeed related to the *Astyanax scabripinnis* species complex. The following lots were cited as *A. obscurus*

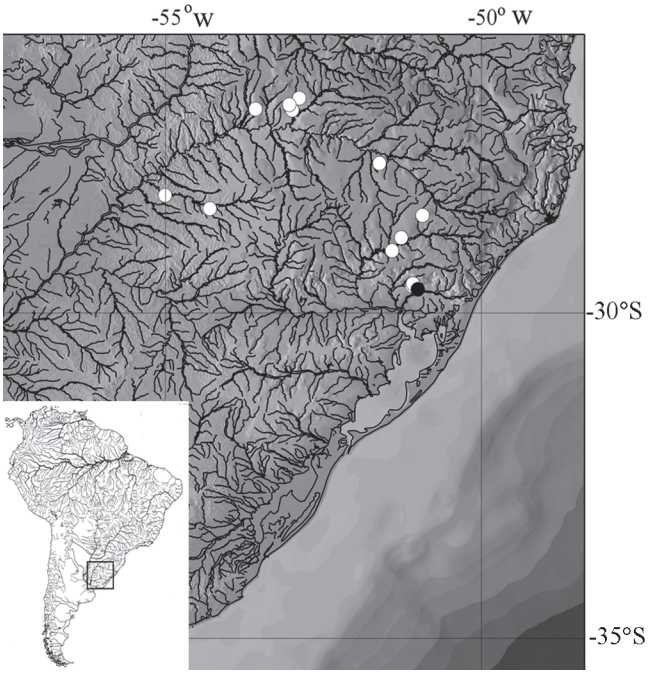

Fig. 9. Map of southern Brazil and Uruguay, showing the distribution of the material examined of *Astyanax xiru*. Some symbols represent more than on lot or locality. Black circle = type locality.

by Bertaco & Lucena (2010). All from laguna dos Patos system, Rio Grande do Sul State, Brazil: MCP 15396, 13, 65.5-87.9 mm SL, tributary of arroio Feitoria, Sapiranga, *ca.* 29º35'S 51º06'W. MCP 20017, 2, 42.1-76.7 mm SL; MCP 20040, 13, 25.9-44.5 mm SL; MCP 21331, 4, 75.9-77.9 mm SL, arroio Feitoria, Sapiranga, *ca.* 29º34'S 51º00'W.

Discussion

The three new species were herein assigned to *Astyanax* according to the traditional definition of the genus given by Eigenmann (1921, 1927). However, none of the characters used by Eigenmann are unique to the genus along with the large number of species assigned to it, makes a difficult task to understand the boundaries of the genus.

Although it is not the aim of this study to propose hypotheses of relationships of three new species, we can make some assumptions based on the phylogeny of Mirande (2010). Even with several provisional clades that need to be tested in the future, as the own author, this is the most comprehensive phylogenetic analysis in terms of terminal taxa and characters, available so far.

According to Mirande (2010), the subfamily Tetragonopterinae (node 224) is defined by a not exclusive synapomorphy, the presence of two pairs of uroneurals. The three new species have one pair of uroneurals, so would not be included in this subfamily.

The share of absence of a dorsal expansion in the rhinosphenoid and the presence of a tubule with anterior branch running parallel to anterior of maxilla and reaching one third of its length (tubule anastomosed in *Astyanax dissensus*) places *A. xiru*, *A. procerus*, and *A. dissensus* in the species group of node 201 (see Mirande, 2010: fig. 128). This node have two branched, one named of *Hyphessobrycon luetkenii* clade, where the *A. dissensus* could be positioned by presence of posterior extent of ventral process of quadrate falling short posterior margin of sympletic, synapomorphy not exclusive of clade.

The other two species, *A. procerus* and *A. xiru*, have the synapomorphies that defined the node 200 (*sensu* Mirande, 2010): fourth infraorbital approximately square or more developed longitudinally than dorsoventrally, coronomeckelian situated mainly dorsal to Meckel cartilage and 24, or less, branched anal-fin rays. In this same group are the *A. paris* clade and the node 199 (*sensu* Mirande, 2010). On the other hand, *A. xiru* not shares the synapomorphies that defined each of these clades (absence of bony hooks on fin rays and possession of several maxillary teeth (*Astyanax paris* clade) and ventral margin of horizontal process of anguloarticular perpendicular to laterosensory canal of dentary (node 199 - *sensu* Mirande, 2010).

Astyanax procerus does not have bony hooks on fins, but otherwise is polymorphic regarding the synapomorphy that involves the process of horizontal anguloarticular. Both species, *A. procerus* and *A. xiru*, have only one tooth in the maxillary, a not exclusive synapomorphy that defines *Astyanax* clade, a branch of the internal node 199 (*sensu* Mirande, 2010).

Considering the hypothesis of Mirande (2010) we find that the three new species are not placed with members of Tetragonopterinae but in a distinct clade, which are species of *Astyanax* and other polyphyletic genera.

Along *Astyanax* species that occur in the rio Uruguay basin and laguna dos Patos and rio Tramandaí systems, *A. dissensus*, *A. ojiara*, and one undescribed species (MCP 10413), are the ones with a larger and heptacuspidate tooth in the maxillary. However, *A. dissensus* differs from undescribed species by the caudal peduncle depth (smaller in *A. dissensus*) and by the abrupt decrease of the dentary teeth from the fourth tooth (from the fifth tooth in *A. dissensus*), and from *A. ojiara* by the head length (smaller in *A. dissensus*) and by the presence of bony hooks only anal-fin rays of males in *A. dissensus* (*vs*. all fins). In the remaining species, or the maxillary is toothless or when presents the teeth are not distally expanded, when compared with the maxillary tooth of the new species, and have usually three to five cusps.

The diversity of *Astyanax* in the Uruguay basin, laguna dos Patos and rio Tramandaí systems is high, with sixteen species are reported for these hydrographic basins (Table 2), and there are additionally at least three undescribed species being studied by us. Among these geographic

Table 2. *Astyanax* species recognized from rio Uruguay basin, and laguna dos Patos and rio Tramandaí systems by drainage. * = restrict to the headwaters habitats. ** = first record for Rio Grande do Sul, Brazil.

Species	Uruguay	laguna dos Patos	Tramandaí
Astyanax aramburui	X		
Astyanax brachypterygium *	X	X	
*Astyanax cremnobates**		X	X
Astyanax dissensus new species	X	X	X
Astyanax sp. aff. *fasciatus*	X	X	X
Astyanax eigenmanniorum	X	X	X
Astyanax henseli	X	X	
Astyanax jacuhiensis	X	X	X
Astyanax laticeps	X	X	X
*Astyanax obscurus**		X	
*Astyanax ojiara**	X		
*Astyanax paris**	X		
Astyanax procerus new species		X	
*Astyanax saguazu***	X	X	
Astyanax stenohalinus	X	X	
Astyanax xiru new species	X	X	

distributions we can observe two distributional trends: 1) species restricted to uppermost headwaters of river drainages, and 2) widespread species occurring in the middle and lower river portions of the river drainages. In the first case are included five species that have the characters and general body morphology of the *Astyanax scabripinnis* species complex (Bertaco & Lucena, 2006). The remaining species have wide distribution and occurring usually in the middle and lower portions of river drainages, including other adjacent basins. The three new species are sympatric and syntopic only in the Taquari-Antas drainage. On other hand, it is probable that *A. dissensus* and *A. xiru* are syntopic due the similar distribution pattern in upper rio Uruguay basin, but so far this was not observed.

The new species recognized herein do not fit the definitions of the *A. bimaculatus* and *A. scabripinnis* species complex. *Astyanax procerus* and *A. xiru* have similar branched anal-fin ray counts of *A. scabripinnis* species complex but both have the greatest body depth at dorsal-fin origin (*vs*. vertical passing half of the pectoral fin); *A. procerus* has greater depth body (38.3-46.0% of SL, mean = 41.3% *vs*. smaller of 41%, mean = 30.0-33.0% *sensu* Bertaco & Lucena, 2010). From species outside of this complex and with similar range of branched anal-fin rays *A. procerus* and *A. xiru* differ of *A. bockmanni*, *A. endy*, *A. pampa*, *A. tumbayaensis*, *A. vermilion*, and *A. xavante* by the larger number of the perforated lateral line scales (37-40 *vs*. 32-37); from *A. chico* and *A. hermosus* by the absence or presence of bony hooks only anal- and pelvic-fin rays of males (*vs*. in all fin rays); and from *A. gymnogenys* by the total number of gill rakers of first arch (19-24 *vs*. 16-17). *Astyanax giton*, *A. intermedius* and *A. taeniatus* (southern coastal drainages) have the five anteriormost dentary teeth decreasing gradually as in *A. procerus* and *A. xiru* but they can be distinguished by the presence of one humeral spot (*vs*. two); from *A. giton* and *A. intermedius* by the presence of hooks on the fins of males (*vs.* absence in *A. procerus*); from *A. giton* by the presence of two to four teeth on outer row of premaxilla (*vs.* four to seven in *A. procerus*) and by the orbital diameter 38.2-52.3% of HL (*vs.* 31.5-37.2% in *A. xiru*), and from *A. intermedius* by the presence of a dark and narrow stripe, sometimes more conspicuous behind vertical through origin of dorsal-fin (*vs*. conspicuous and enlarged dark lateral band from second humeral spot to the base of caudal-fin in both new species). From recently species described of rio Iguaçu basin, upper rio Paraná basin, and overlapping branched anal-fin ray counts *A. procerus* and *A. xiru* differ from *A. dissimilis*, *A. longirhinus*, *A. minor*, and *A. serratus* by the number of humeral spot (two *vs*. one), and from *A. bifasciatus* by second and third tooth of inner premaxillary row wide distally with six to seven cusps (*vs*. four to five cusps). Furthermore, all aforementioned species possesses the size and shape of the anteriormost humeral spot distinct of that found in the new species.

Astyanax dissensus has one distally expanded maxillary tooth with seven cusps, an uncommon character among the species on the genus inhabiting the portion cis-andean, and also exhibited by *A. ojiara* and *A. puka* (7-9 cusps). *Astyanax dissensus* is distinguished from *A. puka* by the absence of broad denticles on anterior, lateral and posterior edges of first ceratobranchial gill rakers *versus* presence. See diagnosis for differences from *A. ojiara*.

Astyanax saguazu was described from rio Uruguay basin in Argentina, and is recorded herein for the Rio Grande do Sul and Santa Catarina States, Brazil, extending its current distribution. The specimens analyzed fit the original description proposed by Casciotta *et al*. (2003).

Therefore, in view of the increase number of *Astyanax* species now know occur in the drainages of Rio Grande do Sul State, an identification key for these species is presented. Note that the key is an attempt since the data of some species or were taken from its original descriptions and/or from a few specimens were examined.

Key to the species of *Astyanax* from the rio Uruguay basin and laguna dos Patos and rio Tramandaí systems

1. Anterior humeral spot distinctively oval-shaped 2
1'. Anterior humeral spot vertically elongate or other form but never oval-shaped 3
2. Two diffuse vertical brown bars in the humeral area (the first through humeral spot and the second 2-3 scales behind; branched anal-fin rays 22-28; absence of maxillary teeth; all fins green-yellow pigmented in life ..... *Astyanax jacuhiensis* (laguna dos Patos and rio Tramandaí systems, and rio Uruguay basin)

2'. Humeral spot not crossed by vertical bar and posterior bar absent, with a narrow anteroventral downward extension surpassing the lateral line; branched anal-fin rays 15-23; maxilla with 1 to 3 teeth; all fins red-orange pigmented in life ..... *Astyanax laticeps* (coastal drainages of Uruguay and Brazil to south of the Paraná State and rio Uruguay basin)

3. Presence of two humeral spots, the second diffuse or not 4

3'.Presence of only one humeral spot (except in *A. eigenmanniorum* which may have a faint second humeral spot) 15

4. Maxillary tooth developed, with 6 or 7 cusps 5

4'.Maxillary tooth undeveloped, with 5 or less cusps 6

5. Five scale rows between dorsal-fin origin and lateral line; males with bony hooks on all fins ..... *Astyanax ojiara* (rioYaboti, Missiones, upper rio Uruguay basin in Argentina)

5'.Six to seven scale rows between dorsal-fin origin and lateral line; males with bony hooks on the anal and pelvic fins ..... *Astyanax dissensus* (laguna dos Patos and rio Tramandaí systems, and rio Uruguay basin)

6. Anterior humeral spot vertically elongate with upper portion wider, lower portion narrow and curved, with a pronounced constriction at the junction of both portions. Second and third tooth of inner premaxillary row wide distally, and with six to seven cusps 7

6'. Anterior humeral spot with the dorsal portion slightly wider than ventral portion, with a smooth constriction at the junction of both portions. Second and third tooth of inner premaxillary row narrow, and with three to five cusps 9

7. Prepelvic distance 51.4-55.3% of SL, mean = 53.2%; prepectoral distance 27.6-29.4% of SL, mean = 28.5%; anal-fin base length 20.4-24.4% of SL, mean = 22.6% ..... *Astyanax obscurus* (Caí and Taquari-Antas river drainages, laguna dos Patos system)

7'.Prepelvic distance 47.5-52.6% of SL, mean = 49.6%; prepectoral distance 23.4-27.3% of SL, mean = 25.3%; anal-fin base length 23.3-29.8% of SL, mean = 25.2% 8

8. Body depth 38.6-46.0% of SL; pelvic-fin length 16.1-18.7% of SL, mean = 17.2%; dorsal-fin length 24.1-28.7% of SL, mean = 26.0%; males without bony hooks on the fins ..... *Astyanax procerus* (rio Jacuí and Taquari-Antas river drainages, laguna dos Patos system)

8'.Body depth 32.5-37.5% of SL; pelvic-fin length 13.6-17.1% of SL, mean = 15.3%; dorsal-fin length 21.1-25.4% of SL, mean = 23.1%; males with bony hooks on the anal and pelvic fins ..... *Astyanax xiru* (Caí and Taquari-Antas river drainages and upper rio Jacuí, laguna dos Patos system, and upper rio Uruguay basin)

9. Branched anal-fin rays 12-18 10

9'.Branched anal-fin rays 20-31 11

10. Branched anal-fin rays 12-16, usually 13-14, mean = 14.0; small orbital diameter 24.8-34.8% of HL, mean = 29.0%; large caudal peduncle depth 12.2-15.3% of SL, mean = 13.6% ..... *Astyanax brachypterygium* (upper rio Uruguay basin and upper rio das Antas basin, rio Jacuí basin)

10'.Branched anal-fin rays 14-18, usually 16-17, mean = 16.1; large orbital diameter 28.1-37.7% of HL, mean = 32.1% in paratypes and mean = 35.1% in non-types see Bertaco & Malabarba, 2001: fig. 6; small caudal peduncle depth 10.4-14.2% of SL, mean = 12.9% ..... *Astyanax cremnobates* (upper portions of rio Jacuí and rio Tramandaí drainages)

11. Lateral line scales 34-36; total number of gill rakers of first arch 18-23 12

11'.Lateral line scales 37-41; total number of gill rakers of first arch 22-30 13

12. Maxilla with 3 to 4 teeth; two humeral spots (second humeral spot darkened) ..... *Astyanax paris* (upper rio Uruguay basin)

12'.Maxilla with one tooth; one or two humeral spots (when present the second humeral spot is diffuse) .... *Astyanax eigenmanniorum* (laguna dos Patos and rio Tramandaí systems, and rio Uruguay basin)

13. Anal-fin origin at vertical through base of last dorsal-fin rays or posterior; 15-19 gill rakers on lower branch of first arch; males with bony hooks in the anal and pelvic fins ..... *Astyanax henseli* (laguna dos Patos system and rio Uruguay basin)

13'.Anal-fin origin at vertical through base of sixth and seventh branched dorsal-fin rays; 11-15 gill rakers on lower branch of first arch 14

14. Orbital diameter 41.1-45.5% of HL, mean = 43.2%; 5 scale rows between lateral line and pelvic-fin origin; males without bony hooks on the fins ..... *Astyanax saguazu* (rio Uruguay basin)

14'.Orbital diameter 33.3-41.4% of HL, mean = 38.9 %; 6-7 scale rows between lateral line and pelvic-fin origin; males with bony hooks in all fins .... *Astyanax stenohalinus* (laguna dos Patos system and rio Uruguay basin)

15. Humeral spot extending over the series of scales above and below the lateral line, forming a uniform wedge, and extending over 5 to 6 horizontal series of scales (lower portion extending over two horizontal series of scales below lateral line); lateral line scales 34-36; total number of gill rakers 18-23; branched anal-fin rays 20-25 .... *Astyanax eigenmanniorum* (laguna dos Patos and rio Tramandaí systems, and rio Uruguay basin)

15'.Humeral spot located usually above of the lateral line scales, not forming a uniform wedge, and rarely extending over 1 or 2 horizontal series of scales below lateral line (totalizing 4 to 5 horizontal series of scales); lateral line scales 37-42; total number of gill rakers 22-29; branched anal-fin rays 23-29 16

16. Third infraorbital with one branch of laterosensory canal directed ventrally, and with pores; bony hooks in all fin of males; presence of tubercles over head and scales; humeral spot diffuse, oval-shaped or trapezoidal, located above lateral line ..... *Astyanax aramburui* (lower rio Uruguay and rio Paraná basins)

16'.Third infraorbital with branch of laterosensory canal directed ventrally, absent; bony hooks in anal and pelvic fin rays of males; absence of tubercles; humeral spot usually conspicuous, vertically elongate and located above of the lateral line scales (in some specimens the humeral spot is located above of lateral line) .... *Astyanax* aff. *fasciatus* (*sensu* Melo & Buckup, 2006; laguna dos Patos and rio Tramandaí system, and middle and lower rio Uruguay basin)

Comparative material. In addition to the comparative material listed in Bertaco & Lucena (2006, 2010), the following specimens were analyzed: **Argentina, Misiones:** *Astyanax ita*, MLP 9599, 60.6 mm SL, holotype, arroyo Tateto, a headwater of Arroyo Deseado, rio Iguaçu basin. *Astyanax paris*, MLP 9584, 70.8 mm SL, holotype, headwater of arroyo Yabotí-Guazú, rio Uruguay basin. *Astyanax tupi*, MACN 8646, 70.1 mm SL, holotype, arroyo Cuñapirú in Balneario de Aristóbulo del Valle. AI 128, 4 paratypes, 55.3-68.4 mm SL, arroyo Cuñapirú Chico. *Astyanax saguazu*, MLP 9604, 5 paratypes, 59.8-65.6 mm SL, headwater of arroyo Once Vueltas, rio Uruguay basin. **Brazil, Rio Grande do Sul:** *Astyanax eigenmanniorum*, MCP 10073, 3, 49.8-53.6 mm SL; MCP 8699, 4, 39.5-57.4 mm SL; MCP 10758, 4, 36.0-46.4 mm SL. *Astyanax* sp. aff. *fasciatus*, MCP 9086, 2, 47.3-63.0 mm SL, rio dos Sinos, laguna dos Patos system, Taquara. MCP 34927, 26, 63.2-83.5 mm SL, tributary of arroio Brum, rio Ijuí drainage, rio Uruguay basin, Cerro Largo. MCP 13545, 16, 77.7-103.0 mm SL, mouth of rio Ijuí-Mirim, rio Uruguay basin. *Astyanax henseli*, ZMB 7479, 75.5 mm SL, holotype, Porto Alegre. MCP 46952, 6, arroio Brum, tributary of rio Ijuí (right bank), Cerro Largo, rio Uruguay basin. UFRGS 3573, 8, 25.9-50.7 mm SL, rio dos Sinos in the N. S. do Monte Serrat bridge, rio Jacuí drainage, Santo Antônio da Patrulha. *Astyanax jacuhiensis*, 5, 51.4-54.5 mm SL, rio Maquiné, rio Tramandaí system. MCP 13049, 3, 144.8 mm SL, rio Uruguay at harbor of Santo Izidro, Uruguay basin. *Astyanax saguazu*, MCN 19630, 71, 45.0-80.8 mm SL, rio Ibirapuitã, rio Ibicuí drainage, Santana do Livramento. MCP 41486, 2, 67.8-75.9 mm SL, rio Forquilha, road Maximiliano de Almeida-Machadinho, Machadinho. *Astyanax* sp., MCP 10413, 18, 43.1-59.9 mm SL, Ernestina dam, beach on the camping, Passo Fundo. **Santa Catarina:** *Astyanax saguazu*, MCP 20889, 4, 61.5-82.9 mm SL, arroio Mondaizinho, on the vicinal road Mondaí-Itapiranga, *ca*. 10 km W from Mondaí. MCP 40135, 4, 67.6-92.3 mm SL, rio Lageado Sertão, at the bridge on the road BR-158. *Astyanax paris*, MCP 40063, 2, 60.7-63.3 mm SL, rio São Domingos, road to Cunha Porã (BR 158), rio Uruguay basin. **Uruguay:** *Astyanax stenohalinus*, MHNM 582-1, holotype, 67.4 mm SL, Laguna Mazangano, Cerro Largo. MHNM 1051, 15, 57.8-77.6 mm SL, laguna Tropa Vieja, arroyo Pando basin, rio La Plata basin.

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