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Revisão taxonômica do gênero *Trichomycterus* Valenciennes, 1832 (Siluriformes: Trichomycteridae) no sistema da laguna dos Patos.

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Orientador: Prof. Dr. Luiz Roberto Malabarba

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Aprovada em_____de_____de_____.

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Dr. Mário César Cardoso de Pinna

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Dr. Richard Peter Vari

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Dr. Wolmar Benjamin Wosiacki

Ao meu pai, minha mãe e meu irmão.

To be yourself is all that you can do (Audioslave)

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Sumário

Resumo

O gênero *Trichomycterus* é revisado no sistema da laguna dos Patos e cinco espécies novas são reconhecidas. *Trichomycterus tropeiro* Ferrer & Malabarba tem distribuição restrita, ocorrendo somente na porção mais superior do rio das Antas. *Trichomycterus* sp. n. A distribui-se na porção superior das bacias dos rios das Antas e Caí. *Trichomycterus* sp. n. B é endêmica da bacia do rio da Prata, tributário do rio das Antas. *Trichomycterus* sp. n. C é amplamente distribuída nos cursos superiores da bacia do rio Jacuí e tributários do rio Taquari-Antas. *Trichomycterus* sp. n. D é endêmica do curso superior do rio do Sinos. As novas espécies distinguem-se de grande parte de seus congêneres do sul e sudeste do Brasil pelo baixo número de raios na nadadeira peitoral (I+5-6) e o primeiro raio da nadadeira peitoral não prolongado como filamento, exceto *T. davisi*, *T. mboycy*, *T. naipi*, *T. papilliferus*, *T. plumbeus* e *T. tropeiro*, distinguindo-se destas por outros caracteres.

Abstract

The genus *Trichomycterus* from laguna dos Patos system is reviewed and five species are recognized. *Trichomycterus tropeiro* Ferrer & Malabarba has a restricted range and is endemic from the uppermost portion of the rio das Antas. *Trichomycterus* sp. n. A is distributed in upper portion of rio das Antas and rio Caí basins. *Trichomycterus* sp. n. B is endemic from rio da Prata basin, tributary of rio das Antas. *Trichomycterus* sp. n. C is widely distributed in upper portion of rio Jacuí basin and tributaries of rio Taquari-Antas. *Trichomycterus* sp. n. D is endemic from upper portion of rio dos Sinos. The new species are distinguishable from most congeners in the southeast and southern Brazil, except from *T. davisi*, *T. mboycy*, *T. naipi*, *T. papilliferus*, *T. plumbeus*, and *T. tropeiro* by the lower number of pectoral-fin rays (I+5-6) and by the first pelvic-fin ray not prolonged as filament. Others characters distinguish the new taxa from these six species.

Introdução

A família Trichomycteridae é um grupo monofilético bem corroborado e coeso (Baskin, 1973; de Pinna, 1998; Datovo & Bockmann, 2010). Os tricomicterídeos são caracterizados, principalmente, pela presença de um sistema opercular altamente modificado composto pelos ossos opercular e interopercular providos de odontódeos (de Pinna, 1998; Adriaens *et al.*, 2010). Acredita-se que esse sistema permite uma locomoção por impulsos ("elbowing locomotion") nos tricomicterídeos basais e auxilia os ectoparasitas das subfamílias Stegophilinae e Vandelliinae prenderem-se aos hospedeiros e adentrar suas cavidades branquiais (Adriaens *et al.*, 2010). A possibilidade desse aparato opercular facilitar a transposição de cachoeiras, poderia explicar a presença de muitas espécies da família Trichomycteridae nas áreas montanhosas da América do Sul (de Pinna, 1998).

Outras características de trichomycterídeos são a presença de três pares de barbilhões (maxilares e rictais situados nos cantos da boca, e nasais situados anteriormente as narinas anteriores); ausência de espinhos nas nadadeiras peitorais e dorsal; presença de um raio procorrente anterior na nadadeira dorsal; ausência total de um mecanismo "spine-locking" na nadadeira dorsal; nadadeira dorsal posicionada na parte média ou posterior da metade do comprimento padrão; presença de I+4 raios nas nadadeiras pélvicas e ausência de nadadeira adiposa (de Pinna & Wosiacki, 2003).

Segundo Eschmeyer & Fong (2012), são reconhecidas 253 espécies válidas pertencentes à família Trichomycteridae e classificadas em sete subfamílias monofiléticas diagnosticadas por caracteres exclusivos (Copionodontinae, Trichogeninae, Sarcoglanidinae, Glanapteryginae, Tridentinae, Stegophilinae e Vandelliinae), e Trichomycterinae, um grupo parafilético diagnosticado basicamente pela ausência de especializações das outras subfamílias (Baskin, 1973; Costa e Bockmann, 1993; de Pinna, 1998; Datovo & Bockmann, 2010).

Apesar de Arratia (1990) propor quatro caracteres compartilhados por alguns membros de Trichomycterinae, espécies como *Trichomycterus hasemani* (Eigenmann, 1914) e *Trichomycterus johnsoni* (Fowler, 1932) não foram incluídas no seu estudo, e são mais relacionadas a outras subfamílias de Trichomycteridae (de Pinna, 1989). Através de uma análise abrangente, envolvendo 61 espécies de Trichomycterinae e 13 espécies como grupo externo, Wosiacki (2002) novamente reconhece o polifiletismo do grupo.

A subfamília Trichomycterinae é composta por seis gêneros: *Bullockia* Arratia, Chang, Menu-Marque & Rojas, 1978, *Eremophilus* Humboldt, 1805, *Hatcheria* Eigenmann, 1909 e *Rhizosomichthys* Miles, 1943, monofiléticos e monotípicos; *Silvinichthys* Arratia, 1998, monofilético e composto por três espécies; e *Trichomycterus* Valenciennes, 1832, parafilético contendo mais de 145 espécies válidas (Eschmeyer & Fong, 2012).

O gênero *Trichomycterus* é o mais problemático em termos sistemáticos na família Trichomycteridae devido a três motivos: parafiletismo do grupo; história taxonômica longa e complicada com muitos nomes disponíveis e aplicabilidade duvidosa; e conhecimento incompleto da real diversidade das espécies (de Pinna, 1998).

O parafiletismo de *Trichomycterus* foi demonstrado por de Pinna (1989) e corroborado em análises mais recentes, realizadas com dados morfológicos (Wosiacki, 2002), moleculares (Sato, 2007) e musculares (Datovo & Bockmann, 2010).

A longa história taxonômica é comprovada pela descrição da espécie tipo (*Trichomycterus nigricans* Valenciennes, 1832) ainda no século XIX e a grande quantidade de espécies descritas até o ano de 1950 (mais de 70 espécies válidas). Por vezes, essas descrições antigas são baseadas em poucos caracteres, o que dificulta estudos taxonômicos com o grupo. A afirmação feita por de Pinna (1998) sobre o conhecimento incompleto da real diversidade das espécies do gênero, datada a mais de dez anos, ainda é válida, pois em trabalhos recentes com o grupo são citadas espécies de *Trichomycterus* reconhecidas, porém não descritas (*cf.* Bockmann *et al.*, 2004; Ferrer & Malabarba, 2010).

O que ainda dificulta os trabalhos realizados com o gênero *Trichomycterus* é a sua ampla distribuição geográfica com espécies ocorrendo em praticamente toda a região Neotropical abrangendo ambos os lados da Cordilheira dos Andes, desde a Costa Rica ao norte até o centro do Chile ao sul. Grande parte das espécies habitam ambientes de cabeceiras e pequenos cursos d'água correntosos, caracterizados por águas claras e frias com leitos pedregosos (de Pinna, 1998). Muitas espécies do gênero têm distribuição geográfica restrita e apresentam um pronunciado grau de endemismo (de Pinna, 1992; Malabarba *et al.*, 2009; Nogueira *et al.*, 2010; Ferrer & Malabarba, 2011).

O gênero *Trichomycterus* está presente nas principais drenagens do Rio Grande do Sul (sistemas da laguna dos Patos e do rio Tramandaí e bacia do rio Uruguai), no entanto, nenhum estudo taxonômico contemplou o grupo nessa região. Malabarba *et al.* (2009) reconheceram, pelo menos, duas espécies distintas de *Trichomycterus* na região

do Planalto das Araucárias (Rio Grande do Sul e Santa Catarina) e afirmam que o grupo necessita de uma revisão taxonômica urgente na região, sendo as espécies ocorrentes na área possivelmente novas.

Objetivos

Os objetivos gerais do projeto são:

- Contribuir para o conhecimento da fauna de peixes neotropicais;
- Contribuir para a compreensão dos padrões de distribuição da ictiofauna neotropical.

Os objetivos específicos do projeto são:

- Revisar o gênero *Trichomycterus* no sistema da laguna dos Patos;
- Descrever possíveis espécies novas, visto que nenhum estudo taxonômico contemplou o gênero na região proposta;
- Delimitar a distribuição geográfica das espécies descritas durante o estudo;
- Elaborar uma chave de identificação para as espécies de *Trichomycterus* para o sistema da laguna dos Patos.

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Capítulo 1

A new *Trichomycterus* lacking pelvic fins and pelvic girdle with a very restricted range in Southern Brazil (Siluriformes: Trichomycteridae)

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A new *Trichomycterus* lacking pelvic fins and pelvic girdle with a very restricted range in Southern Brazil (Siluriformes: Trichomycteridae)

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Abstract

Trichomycterus tropeiro, new species, is described from the headwaters of the rio das Antas, laguna dos Patos system, Southern Brazil. *Trichomycterus tropeiro* is distinguishable from other species of the genus by the absence of pelvic fins and pelvic girdle, except from *Trichomycterus candidus* and *Trichomycterus catamarcensis*. It differs from these two species in several counts and measurements. The apparent endemism of the species is discussed.

Key words: Neotropical, Laguna dos Patos system, Endemic fish, *Trichomycterus candidus*, *Trichomycterus catamarcensis*

Resumo

Trichomycterus tropeiro, nova espécie, é descrita para as cabeceiras do rio das Antas, sistema da laguna dos Patos, sul do Brasil. *Trichomycterus tropeiro* distingue–se das demais espécies do gênero pela ausência de cintura e nadadeiras pélvicas, com exceção de *Trichomycterus candidus* e *Trichomycterus catamarcensis*. Distingue–se destas duas espécies em várias contagens e medidas corporais. O aparente endemismo da espécie é discutido.

Introduction

The family Trichomycteridae has a wide geographical distribution in the Neotropic, occurring from Costa Rica to Argentina and on both sides of the Andes (de Pinna &

Wosiacki 2003). The genus *Trichomycterus* is the largest of the family containing over 135 valid species (Eschmeyer & Fricke 2011). Many species of the genus inhabit headwaters and small streams, characterized by clear and cold waters with fast current and rocky bottom (de Pinna 1998), and present, generally, restricted geographic distribution and high endemism (de Pinna 1992; Malabarba *et al.* 2009).

Despite the common occurrence of the species of the genus in most tributaries of the rio Uruguay and laguna dos Patos basins in Southern Brazil, taxonomic studies of this genus have been neglected in that region. The species of *Trichomycterus* described from Southern Brazil are restricted in their ranges to the States of the Paraná and Santa Catarina, not reaching the rio Uruguay and laguna dos Patos basins in the Rio Grande do Sul State, Brazil.

The extensive analysis of specimens of *Trichomycterus* collected in the laguna dos Patos drainage revealed one apparently highly endemic new species from the headwaters of rio das Antas, easily distinguished from most species of the genus by the lack of pelvic girdle and associated elements. The new species is described herein, along with a discussion of the apparent endemism of the species.

Material and Methods

Measurements were made point-to-point with digital calipers to the nearest 0.1 mm on the left side of the specimens. The measurements follow Tchernavin (1944) for the length of barbells, Wosiacki and de Pinna (2008) for the peduncle caudal length and depth and for the supraorbital pore distance, and Costa (1992) for the remaining measurements. Scapular girdle width was taken in between the insertions of the pectorals fins.

Twenty one specimens out of 22 available were measured (except for UFRGS 8815) and four specimens were cleared and counterstained (c&s) for cartilage and bone following the method proposed by Taylor and Van Dyke (1985) for osteological analysis. The counts of fin-rays include the anterior unbranched and unsegmented rays, unbranched segmented rays and branched segmented rays as used by Bockmann and Sazima (2004). Vertebral counts do not include those in the Weberian complex and the compound caudal centrum (PU1+U1) is counted as one element (de Pinna *et al.* 2010). The nomenclature for latero-

sensory canal system and associated pores followed Arratia and Huaquin (1995). Morphological data for *Trichomycterus candidus* (Miranda Ribeiro, 1949) and *Trichomycterus catamarcensis* Fernández & Vari, 2000 are based on literature (Barbosa & Costa 2003; Fernández & Vari 2000).

The material examined belongs to the following institutions: LIRP (Laboratório de Ictiologia de Ribeirão Preto, Universidade de São Paulo), Ribeirão Preto; MCP (Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul), Porto Alegre; MNRJ (Museu Nacional, Universidade Federal do Rio de Janeiro), Rio de Janeiro; MZUSP (Museu de Zoologia da Universidade de São Paulo), São Paulo; UFRGS (Departamento de Zoologia da Universidade Federal do Rio Grande do Sul), Porto Alegre.

***Trichomycterus tropeiro*, new species**

(Figs. 1–2, Table 1)

Holotype. MCP 46171, 82.3 mm SL; Brazil: State of Rio Grande do Sul, Municipality of São José dos Ausentes; rio das Antas, 28º47'01"S 49º58'56"W, D. Gelain, J. Bastos, T. Dias, T. Hasper, 16 Jan 2001.

Paratypes. MCP 10624, 1, 87.4 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Cambará do Sul, locality of Ouro Verde, rio das Antas, 28º51’00”S 50º01’25”W, C.A. Lucena, L. R. Malabarba, R. Reis, 1 May 1985. UFRGS 4845, 2, 39.5–39.7 mm SL, Brazil, State of Rio Grande do Sul, Municipality of São José dos Ausentes, stream tributary of the rio das Antas, 28º48’36”S 49º59’36”W, L. R. Malabarba, A. Cardoso, A. Schwarzbold, L. Sazinski, 6 Jan 2000. All the following lots from Brazil, State of Rio Grande do Sul, Municipality of São José dos Ausentes, rio das Antas: MCP 46172, 1, 81.6 mm SL, collected with holotype. MCP 46173, 1, 58.3 mm SL, 28º47'07"S 49º58'55"W, A. Cardoso, D. Gelain, J. Bastos, T. Hasper, 21 Apr 2001, LIRP 8154, 1, 96.1 mm SL, 28º47'01"S 49º58'56"W, D. Gelain, J. Anza, J. Bastos, T. Hasper, 25 Aug 2000. LIRP 8155, 1, 71,7 mm SL, 28º47'01"S 49º58'56"W, D. Gelain, J. Bastos, J. Anza, T. Dias, T. Hasper, 30 Jul 2001. MNRJ 38508, 1, 77.7 mm SL, 28º47'07"S 49º58'55"W, D. Gelain, J. Anza, J. Bastos, T. Hasper, 29 Oct 2000. MNRJ 38509, 1, 74.6 mm SL, 28º47'07"S 49º58'55"W, D. Gelain, J. Anza, J. Bastos, T. Hasper, 20 Dec 2000. UFRGS 8816, 1, 77.7

mm SL, 28º47'07"S 49º58'55"W, D. Gelain, J. Anza, J. Bastos, T. Hasper, 20 Dec 2000. MZUSP 108296, 1, 55.5 mm SL, 28º47'11"S 49º59'04"W, A. Cardoso, A. Schwarzbold, L. R. Malabarba, L. Sazinski, 6 Jan 2000. MZUSP 108297, 1, 83.3 mm SL, 28º47'07"S 49º58'55"W, D. Gelain, J. Anza, J. Bastos, L. R. Malabarba, T. Dias. 17 Mar 2001. MZUSP 108298, 1, 34.5 mm SL, 28º47'07"S 49º58'55"W, A. Cardoso, D. Gelain, J. Bastos, T. Hasper, 21 Apr 2001. UFRGS 5563, 1, 91.7 mm SL, 28º47'07"S 49º58'55"W, A. Cardoso, D. Gelain, J. Bastos, T. Hasper, 21 May 2001. UFRGS 8813, 2 (c&s), 73.4–84.0 mm SL, 28º47'07"S 49º58'55"W, D. Gelain, J. Anza, J. Bastos, T. Hasper, 22 Jun 2001. UFRGS 8815, 1 (c&s), 62.8 mm SL, 28º47'01"S 49º58'56"W, D. Gelain, J. Anza, J. Bastos, T. Hasper, 20 Dec 2000. UFRGS 8818, 2, (1 c&s), 46.8–85.1 mm SL, 28º47'01"S 49º58'56"W, D. Gelain, J. Anza, J. Bastos, T. Dias, T. Hasper, 19 May 2001. UFRGS 8819, 1, 28.0 mm SL, 28º47'07"S 49º58'55"W, D. Gelain, J. Anza, J. Bastos, L. R. Malabarba, T. Dias, 17 Mar 2001.

Diagnosis. *Trichomycterus tropeiro* is distinguishable from other species of the genus by the absence of the pelvic girdle, except *T. candidus* and *T. catamarcensis*. *Trichomycterus tropeiro* differs from *T. candidus* by head length (20.4–23.1 *vs.* 14.7–16.1% SL); pectoral-fin length (12.8–14.7 *vs.* 8.6–9.3% SL); interorbital distance (19.6–25.3 *vs.* 26.6–32.3% HL); number of dorsal procurrent caudal-fin rays (13–14 *vs.* 16–19); ventral procurrent caudal-fin rays (9–10 *vs.* 16–18); pectoral-fin unbranched rays (6 *vs.* 5); and branchiostegal rays (9 *vs.*8). *Trichomycterus tropeiro* differs from *T. catamarcensis* by body depth (13.9–18.1 *vs.* 8.9–12.7% SL); caudal peduncle depth (10.9–13.5 *vs.* 7.1–8.5% SL); head length (20.4–23.1 *vs.* 15.6–19.4% SL); interorbital distance (19.6–25.3 *vs.* 26.3–34.7% HL); number of dorsal-fin branched rays (7 *vs.* 8–9); pectoral-fin branched rays (6 *vs.* 7); anal-fin branched rays (5 *vs.* 7–9); ventral procurrent caudal-fin rays (9–10 *vs.* 11–12); branchiostegal rays (9 *vs.* 5–6); and pleural ribs (13–14 *vs.* 18–20).

Description. Morphometric data for holotype and paratypes given in Table 1. Body elongate, roughly cylindrical close to head and gradually more compressed in trunk towards caudal-fin. Dorsal e ventral profiles of head straight. Profiles of trunk straight dorsally and slightly convex ventrally. Dorsal and ventral profiles of caudal peduncle straight.

Integument thick, especially over base of dorsal-fin and anal-fin. Small papillae covering entire surface of skin, most prominent on lips and ventral, dorsal, and lateral surfaces of head.

Head wide and depressed, longer than wide, the transversal section at posterior tip of opercle wider than anteriorly at nostril, snout slightly rounded. Lateral region of eye slightly swollen by jaw muscles in both large and small specimens. Eyes rounded, well defined rim, dorsally oriented, covered by thin and transparent skin, not distinctly separated from surface of eyeball. Ocular structures readily visible on surface of skin, not deeply sunken. Orbital rim not free. Anterior nostril larger than posterior nostril, surrounded by fleshy flap of integument, posterolaterally continuous with nasal barbel. Posterior nostril surrounded anteriorly by thin flap of integument. Gill openings not constricted, united to isthmus anteriorly. Five or six branchiostegal rays externally visible from below (9 in c&s), covered with thick skin. Mouth subterminal, its corners laterally or slightly posteriorly oriented. Lower lip with conspicuous fleshy lobes along lateral limits and internal to origin of rictal barbels. Lower lip covered with small papillae. Anterior margin of upper lip rounded. Small papillae on external surface of upper lip and large papillae continuous inside mouth at region of teeth attachment. Upper lip continuous with dorsal surface of head.

Barbels with large bases and tapering gradually toward to the tip. Nasal barbels thick always surpassing posterior margin of eye but not reaching opercular patch of odontodes. Origin of nasal barbels on posterolateral portion of integument flap around anterior nostril. Maxillary barbels reaching or surpassing posterior tip of interopercular patch of odontodes. Rictal barbels shorter than maxillary barbels reaching the interopercular patch of odontodes.

Opercular patch of odontodes rounded with 12–14 odontodes. Interopercular patch of odontodes elongate with 18–24 odontodes. Odontodes on both opercle and interopercle gradually increasing in size and curving medially posteriorly. Odontodes covered by thick integument.

Supraorbital sensory canal complete and infraorbital sensory canal incomplete (Fig. 2). Infraorbital anterior section pores i1 and i3, and posterior section pores i10 and i11.

Supraorbital pores s1, s3 and s6. Two pores s6 paired at interorbital space. Postotic pores po1 and po2. Lateral-line canal very short, with 2 pores (four in two paratypes).

Pectoral-fin with distal margin rounded, I,6 rays, first ray not prolonged as filament. Dorsal-fin with distal margin rounded, semicircular when fin expanded, iii,II,7 rays. Anal-fin slightly smaller than dorsal-fin, with distal margin rounded, ii,II,5 rays, origin at vertical through middle portion dorsal-fin. Pelvic-fin and pelvic girdle absent. Caudal-fin with distal margin straight and the dorsal e ventral edges rounded, II,5–6,II principal rays, branched rays splitting tree times. Procurrent caudal-fin rays 13 or 14 dorsally and 9 or 10 ventrally.

Free vertebrae 37 or 38. Ribs 13 or 14 pairs; first thickest; 10th, 11th, 12th longest; last rib rudimentary. Dorsal-fin pterygiophores 8, first one inserting anterior to neural spine of 19th or 20th vertebrae. Anal-fin pterygiophores 6, first one inserting anterior to hemal spine of 22th or 23th vertebrae.

Coloration in alcohol. Flank and dorsum of body with irregular dark spots variable in size and shape, on lighter background, larger and more concentrated on dorsum of trunk; gradually becoming more scattered and smaller on sides and posterior third of trunk; completely absent in the ventral surface of trunk. Dorsal surface of head with irregular dark blotches variable in size and shape, larger and more concentrated in medial posterior region; gradually becoming more scattered and smaller on lateral and anterior region; completely absent on ventral surface. Opercular and interopercular path of odontodes pigmentation continuous with that on remainder of head. Upper lip with small spots similar to those on rest of head. Lower lip with small dark fields close to its anterior margin. Pectoral-fin with small spots along basal portion, remainder fin without spots and becoming lighter toward to tip. Dorsal-fin with small spots along anterior edge and basal portion, remainder fin without spots becoming lighter toward to tip. Anal-fin with dark pigmentation in basal portion becoming lighter toward to tip, pigmentation generally fainter than other fins. Caudal-fin with small spots along basal portion, remainder fin without spots becoming lighter toward to tip. Nasal and maxillary barbels with dark pigmentation along entire length, on both surfaces (Fig. 1).

Etymology. The name is an allusion to the old drovers paths that connected the States of Rio Grande do Sul and São Paulo and crossed the Municipalities of São José dos Ausentes and Cambará do Sul. A name in apposition.

Distribution. Known from the localities of the type series, three points located in the rio das Antas, two of them very close, and in one tributary stream (Fig. 3). The rio das Antas is part of laguna dos Patos system, having a length of 390 km to its confluence with the rio Guaporé, where both form the rio Taquari, crossing over 140 km before emptying into the rio Jacuí.

Ecological notes. *Trichomycterus tropeiro* occurs in environments with clear water, fast current, bottom composed of gravel, pebbles and stones, above 1000 m. The stomach of the two specimens cleared and stained contained nymphs of Ephemeroptera and larvae of Diptera (Chironomidae) and Trichoptera. The following species of fish occur syntopically with *T. tropeiro*: *Astyanax brachypterygium* Bertaco & Malabarba, 2001; *Astyanax* sp., *Cnesterodon brevirostratus* Rosa & Costa, 1993; *Eurycheilichthys* sp., *Jenynsia eirmostigma* Ghedotti & Weitzman, 1995 and *Pareiorhaphis hystrix* (Pereira & Reis, 2002).

Trichomycterus tropeiro seems to be relatively rare, with low populational densities. Almost all specimens were collected near the same locality, during an one year ecological study with monthly collecting samples. Even with that frequency all the collecting effort resulted in 22 specimens only, with a maximum of two, usually one specimen collected monthly in each locality.

Discussion

Trichomycterus tropeiro is characterized by the absence of pelvic fins and pelvic girdle. A discussion about the historical use of this character in defining genera of Trichomycteridae is clearly reported in Fernández and Vari (2000). In the early studies of the group, *Eremophilus* and *Trichomycterus* were distinguished only by the absence of pelvic fins (*cf.* Cuvier & Valenciennes 1846; Eigenmann 1918). However, subsequent studies revealed that

the loss of pelvic fins occurred independently in several taxa among the Trichomycteridae being a questionable character for establishing phylogenetic relationships in the family (Myers 1944; de Pinna 1989).

Currently there are two species of *Trichomycterus* that lack both pelvic-fin and pelvic girdle: *T. catamarcensis* described from the Andes of Argentina (Fernández & Vari 2000) and *T. candidus* redescribed by Barbosa and Costa (2003) who proposed these new combination (previously *Eremophilus candidus*) based on its relationship with a clade of *Trichomycterus* from Southeastern Brazil.

Trichomycterus tropeiro does not have the pattern of cephalic pores of *Eremophilus* proposed by Arratia (1998) as a synapomorphy in a new definition for the genus, neither the characters used to define the genera *Hatcheria*, *Bullockia*, *Silvinichthys*, *Rhizosomichthys* (*cf.* Eigenmann 1918; Arratia 1998), also belonging to the subfamily Trichomycterinae. The new species also does not share the synapomorphies of the genera *Scleronema* and *Ituglanis* (*cf.* de Pinna 1998; Costa & Bockmann 1993), not included in Trichomycterinae and considered more related to a clade formed by the subfamilies Glanapteryginae, Sarcoglanidinae, Stegophilinae, Tridentinae e Vandellinae (de Pinna 1998; Costa & Bockmann 1993).

In view of these facts, it is suggested that the species presented here is included in the genus *Trichomycterus*. There are three obstacles in tackling in systematics of *Trichomycterus*: the paraphyletic or polyphyletic nature of the group, and the long and complicated taxonomic history, with many available names with doubtful applicability and overwhelming and incompletely known species diversity (de Pinna 1998). Bockmann *et al.* (2004) also refers to the problems of the group and says that few studies have attempted to elucidate the relationships among species of *Trichomycterus*.

In the case of the drainages of southern Brazil, the lack of studies with the genus is still greater, and allows to suppose that the real diversity of the group is far from being elucidated in the area. Besides the species presented here, at least two other undescribed species of *Trichomycterus* are known for the region (de Pinna pers. comm., Datovo pers. comm.).

Trichomycterus tropeiro is known only from a few very close localities in the headwaters of the rio das Antas, more than 1000 m asl. The fact the surrounding region, including most proximally and distantly located headwaters of other tributaries of the rio Jacuí drainage and of the rio Uruguay drainage (Fig. 3), have been extensively collected in the last 20 years with the collection of several specimens of *Trichomycterus*, but without the collection of a single additional specimen of *T. tropeiro*, seems to indicate an extremely high endemism for this species. This seems to be usual among species of *Trichomycterus*, since it is the dominant genus among those bearing restricted-range species (Nogueira *et al*. 2010).

Malabarba *et al*. (2009) have classified the endemic fish species from the upper rio Uruguay and upper rio Jacuí tributaries that occurred exclusively in the "Campos do Planalto das Araucárias" ecoregion (mostly from 750 m asl) as bearing high endemism, *versus* lower endemism in those species with larger distribution ranges but restricted to the upper portions of the rio Uruguay and tributaries and/or the upper portions of the rio Jacuí and tributaries. The species considered with high endemism in the "Campos do Planalto das Araucárias" were restricted to seven genera and five families: *Astyanax* and *Bryconamericus* (Characidae); *Cnesterodon* (Poeciliidae); *Eurycheilichthys* and *Pareiorhaphis* (Loricariidae); *Jenynsia* (Anablepidae); and *Trichomycterus* (Trichomycteridae).

Notably, all the highly endemic species described from those genera to that region have been discovered and described in the last 20 years only, i.e., *Astyanax brachypterygium* Bertaco & Malabarba, 2001; *Astyanax cremnobates* Bertaco & Malabarba, 2001; *Bryconamericus patriciae* da Silva, 2004; *Cnesterodon brevirostratus* Rosa & Costa, 1993; *Eurycheilichthys pantherinus* (Reis & Schaefer, 1992); *Jenynsia eirmostigma* Ghedotti & Weitzman, 1995; *Pareiorhaphis eurycephalus* (Pereira & Reis, 2002); *Pareiorhaphis vestigipinnis* (Pereira & Reis, 1992). Several species, however, are still to be described from the "Campos do Planalto das Araucárias" among the genera *Astyanax*, *Cnesterodon*, *Eurycheilichthys*, *Pareiorhaphis*, and especially *Trichomycterus*. There is apparently one undescribed species of *Eurycheilichthys* occurring in the same geographically restricted range of *T. tropeiro* (Reis, pers. comm.).

The knowledge and description of these species with a high endemism is of extreme relevance. The species with a high endemism in the region began to be described less than two decades and its diversity can be still seen as clearly subestimated (Malabarba *et al*. 2009).

Comparative material. All from Brazil. Bahia State: *Copionodon* sp.: MCP 18310, 1, 64.1 mm SL, rio Lencóis (rio Paraguaçu drainage). Espírito Santo State: *Trichomycterus pantherinus*: MCP 35029, 2, paratypes, 39.6–41.9 mm SL, rio da Prata (rio Santa Maria da Vitória drainage). Goiás State: *Ituglanis mambai*: MCP 42538, holotype, 53.8 mm SL, Lapa do Sumidouro cave (rio Tocantins drainage); MCP 42537, 1, paratype, 68.9 mm SL, collected with holotype. Minas Gerais State: *Trichomycterus brasiliensis*: LIRP 1968, 3, 50.7–100.7 mm SL, rio da Prata basin (rio São Francisco drainage). *Trichomycterus caudofasciatus*: MCP 35030, 2, paratypes, 37.1–38.0 mm SL, rio Caparaó (rio Itabapoana drainage). *Trichomycterus immaculatus*: LIRP 285, 2, 82.2–102.3 mm SL, rio Santo Antônio (rio Paraná drainage). *Trichomycterus itacarambiensis*: MCP 34305, 1, 59.4 mm SL, Olhos d'Água cave (rio São Francisco drainage). *Trichomycterus maracaya*: MCP 34575, 2, paratypes, 30.7–31.7 mm SL, rio Pardo basin (rio Paraná drainage). *Trichomycterus variegatus*: LIRP 647, 3, 43.1–49.8 mm SL, rio São Francisco. Paraná State: *Trichomycterus castroi*: MCP 39099, 1, 48.0 mm SL, riacho do Bugre (rio Iguaçu drainage). *Trichomycterus davisi*: LIRP 4962, 2, 24.1–29.7 mm SL, rio Jordão (rio Iguaçu drainage). *Trichomycterus stawiarski*: MCP 22587, 2, 87.4–94.9 mm SL, rio Cavernoso basin (rio Iguaçu drainage); LIRP 5088, 2, 52.8–60.0 mm SL, reservoir of rio Jordão (rio Iguaçu drainage). Rio de Janeiro State: *Trichomycterus giganteus*: MCP 35028, 3, paratypes, 106.4–130.1 mm SL, rio Guandu–Mirim (rio Guandu drainage). *Trichomycterus potschi*: MCP 29061, holotype, 78.6 mm SL, rio das Cachoeiras. *Trichomycterus zonatus*: LIRP 596, 4, 20.7–27.1 mm SL, rio Preto (rio Paraíba do Sul drainage). São Paulo State: *Trichogenes longipinnis*: MCP 40892, 1 (c&s disarticulated), cachoeira dos Amores. *Trichomycterus candidus*: LIRP 7425, 3, 37.0–49.3 mm SL, ribeirão Bom Jesus (rio Grande drainage). *Trichomycterus iheringi*: LIRP 1055, 2, 77.4–88.9 mm SL, rio Bonito (rio Paraná drainage). *Trichomycterus mimonha*: MCP 18021, 2, 46.3–67.6 mm SL, rio Piquete basin (rio Paraíba do Sul drainage). Rio Grande do Sul State: *Ituglanis* sp.: UFRGS

13600, 1, 75.2 mm SL, arroio Santa Isabel (rio Camaquã drainage). *Scleronema* sp.: UFRGS 8972, 4, 25.5–62.2 mm SL, arroio Abranjo (rio Camaquã drainage). *Trichomycterus* sp.: MCP 41147, 5 (1c&s), 35.5–50.4 mm SL, arroio Engenho (rio Jacuí drainage). *Trichomycterus* sp.: MCP 22699, 4 (1c&s), 29.1–79.0 mm SL, rio Passo Novo (rio Jacuí drainage). *Trichomycterus* sp.: MCP 22785, 1, 59.1 mm SL, rio Soares (rio Taquari-Antas drainage). *Trichomycterus* sp.: MCP 17440, 5 (1c&s), 61.5–29.9 mm SL, tributary of the rio dos Touros (rio Uruguay drainage). Santa Catarina State: *Trichomycterus* sp.: UFRGS 3964, 1, 29.9 mm SL, rio Roseira (rio Uruguay drainage).

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FIGURE 1. *Trichomycterus tropeiro*, MCP 46171, holotype, 82.3 mm SL, from the rio das Antas, Municipality of São José dos Ausentes, State of Rio Grande do Sul, Brazil.

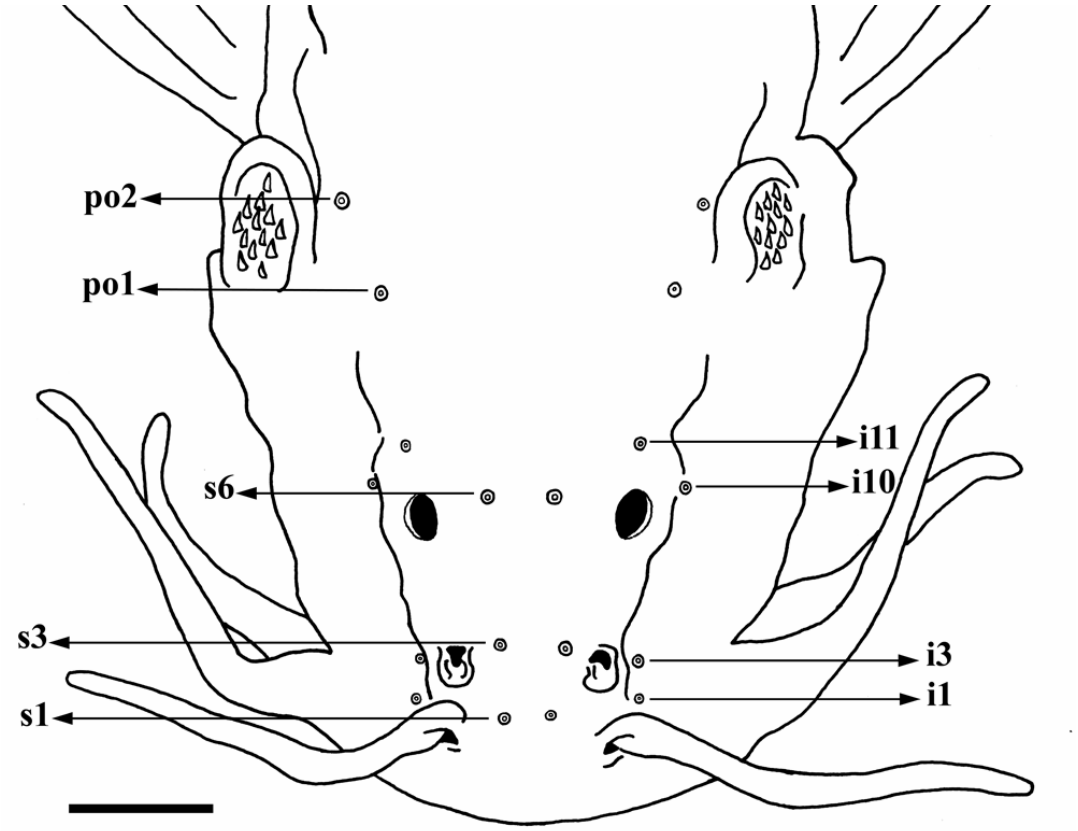

FIGURE 2. Head of *Trichomycterus tropeiro*, MZUSP 108296, paratype, 55.5 mm SL. Dorsal view. Abbreviations: s1, s3 and s6, pores of the supraorbital sensory canal; i1 and i3, pores of anterior section of the infraorbital sensory canal; i10 and i11, pores of posterior section of the infraorbital sensory canal; po1 and po2, pores of the postotic sensory canal. Scale bar = 2 mm.

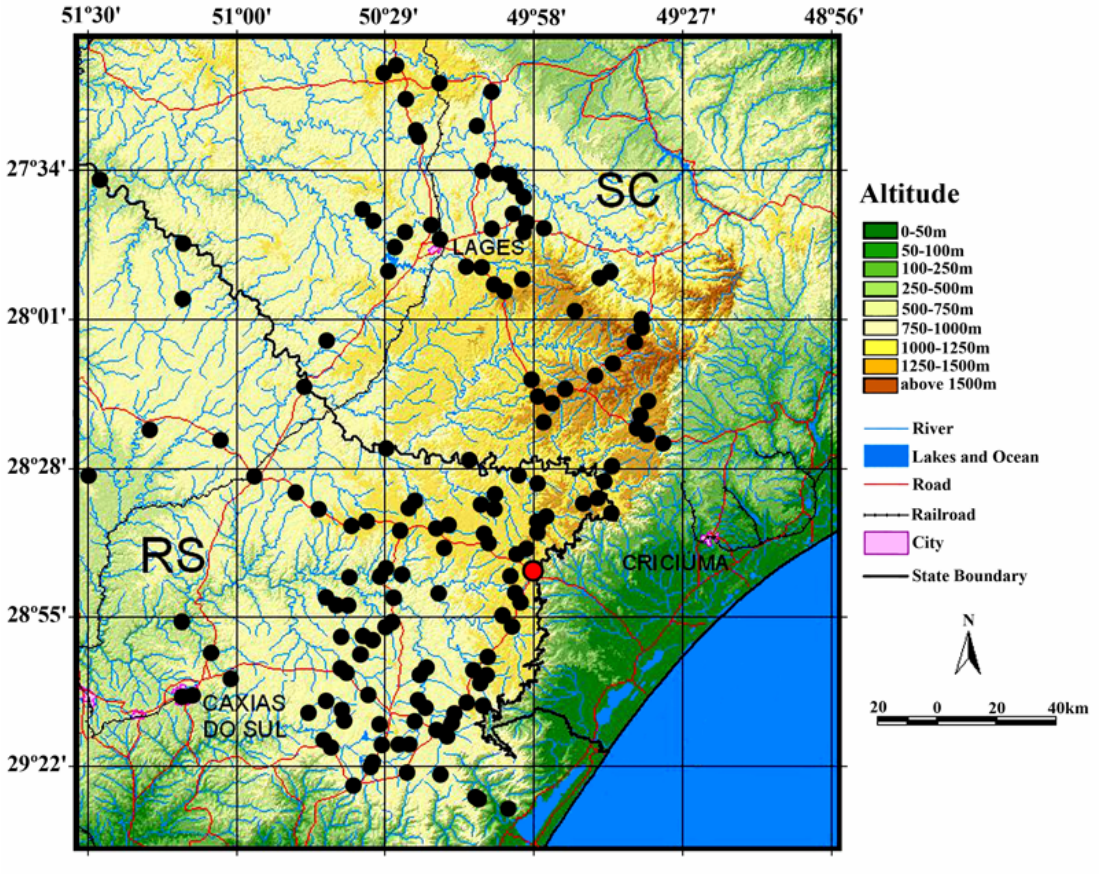

FIGURE 3. Geographic distribution of *Trichomycterus tropeiro* (red circle) and localities sampled around the type locality registered in the fish collections at MCP, MNRJ, MZUSP, and UFRGS (black dots). Modified from Malabarba *et al*. (2009). Each symbol may represent more than one lot.

Capítulo 2

Taxonomic review of the genus *Trichomycterus* Valenciennes (Siluriformes: Trichomycteridae) from the laguna dos Patos system, Southern Brazil

(Manuscrito a ser submetido para o periódico Neotropical Ichthyology)

Taxonomic review of the genus *Trichomycterus* Valenciennes (Siluriformes: Trichomycteridae) from the laguna dos Patos system, Southern Brazil

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The genus *Trichomycterus* from laguna dos Patos system is reviewed and five species are recognized. *Trichomycterus tropeiro* Ferrer & Malabarba has a restricted range and is endemic from the uppermost portion of the rio das Antas. *Trichomycterus* sp. n. A is distributed in upper portion of rio das Antas and rio Caí basins. *Trichomycterus* sp. n. B is endemic from rio da Prata basin, tributary of rio das Antas. *Trichomycterus* sp. n. C is widely distributed in upper portion of rio Jacuí basin and tributaries of rio Taquari-Antas. *Trichomycterus* sp. n. D is endemic from upper portion of rio dos Sinos. The new species are distinguishable from most congeners in the southeast and southern Brazil, except from *T. davisi*, *T. mboycy*, *T. naipi*, *T. papilliferus*, *T. plumbeus*, and *T. tropeiro* by the lower number of pectoral-fin rays (I+5-6) and by the first pelvic-fin ray not prolonged as filament. Others characters distinguish the new taxa from these six species. The distribution of genus on laguna dos Patos system is discussed and a taxonomic key is provided.

O gênero *Trichomycterus* é revisado no sistema da laguna dos Patos e cinco espécies são reconhecidas. *Trichomycterus tropeiro* Ferrer & Malabarba tem distribuição restrita, ocorrendo somente na porção mais superior do rio das Antas. *Trichomycterus* sp. n. A distribui-se na porção superior das bacias dos rios das Antas e Caí. *Trichomycterus* sp. n. B é endêmica da bacia do rio da Prata, tributário do rio das Antas. *Trichomycterus* sp. n. C é amplamente distribuída nos cursos superiores da bacia do rio Jacuí e tributários do rio Taquari-Antas. *Trichomycterus* sp. n. D é endêmica do curso superior do rio do Sinos. As novas espécies distinguem-se de grande parte de seus congêneres do sul e sudeste do Brasil pelo baixo número de raios na nadadeira peitoral (I+5-6) e o primeiro raio da nadadeira

peitoral não prolongado como filamento, exceto *T. davisi*, *T. mboycy*, *T. naipi*, *T. papilliferus*, *T. plumbeus* e *T. tropeiro*, distinguindo-se destas por outros caracteres. A distribuição do gênero é discutida no sistema da laguna dos Patos e uma chave taxonômica é proposta.

Key words: Neotropical, Trichomycterinae, *Trichomycterus tropeiro*, Endemism.

Introduction

Trichomycteridae is a monophyletic group with a distribution that covers practically all of South America, occurring from Costa Rica to Argentina on both sides of the Andes (de Pinna & Wosiacki, 2003). Currently, the family is divided into seven monophyletic subfamilies (Copionodontinae, Glanapteryginae, Sarcoglanidinae, Stegophilinae, Trichogeninae, Tridentinae, and Vandelliinae) and Trichomycterinae, demonstrably non-monophyletic (Baskin, 1973; de Pinna, 1998; Datovo & Bockmann, 2010).

Trichomycterinae is the only present throughout the whole range distribution of the family and despite its vastness in terms of number of species, few genera are recognized in the subfamily (de Pinna & Wosiacki, 2003): *Bullockia* Arratia, Chang, Menu-Marque & Rojas, 1978, *Eremophilus* Humboldt, 1805, *Hatcheria* Eigenmann, 1909, and *Rhizosomichthys* Miles, 1943 are monophyletic and monotypic; *Silvinichthys* Arratia, 1998 is monophyletic with three species; and *Trichomycterus* Valenciennes, 1832 is a paraphyletic group containing over 145 valid species (Eschmeyer & Fong, 2012).

Despite the high number of species described, Ferrer & Malabarba (2011) highlighted the lack of taxonomic studies with this genus in the laguna dos Patos and Uruguay basins in southern Brazil. Regardless the common occurrence of the genus in these basins, *Trichomycterus tropeiro* Ferrer & Malabarba, 2011 endemic to the headwaters of rio das Antas in laguna dos Patos system is so far the unique species recognized for that drainage. In the present study the genus *Trichomycterus* is reviewed in the laguna dos Patos system through an extensive analysis of large collections of new specimens. Four new species are recognized besides *Trichomycterus tropeiro*. Distribution comments and an identification key are given for the species of *Trichomycterus* from the laguna dos Patos system.

Material and Methods

Measurements were made point-to-point with digital calipers to the nearest 0.1 mm. The measurements follow Tchernavin (1944) for the length of barbels, Wosiacki & de Pinna (2008a) for the caudal peduncle length and depth and for the supraorbital pore distance, Ferrer & Malabarba (2011) for the scapular girdle, and Costa (1992) for the remaining measurements.

The nomenclature for osteological structures and latero-sensory canal system and associated pores followed Arratia (1998). Vertebral counts do not include those in the Weberian complex and the compound caudal centrum (PU1+U1) is counted as one element. For osteological analysis 31 specimens were cleared and counterstained (c&s) following the method proposed by Taylor & Van Dyke (1985) and nine disarticulated. The counts of fin rays included the unsegmented rays, unbranched and segmented rays (represented by upper case Roman numerals) and branched and segmented rays (represented by Arabic numerals). The counts for holotypes are represented by asterisk in variable meristics. Number of branchiostegal rays, odontodes, procurrent rays, pterygiophores, ribs, vertebrae and unsegmented rays were counted only in specimens c&s; and the draws of the osteological structures were made only from specimens c&s and disarticulated.

Morphological data for species are based on literature and personal observations. Institutional abbreviations: Coleção Ictiológica da Universidade Federal de Santa Catarina, Florianópolis (CIUFSC); Fundación Miguel Lillo, San Miguel de Tucumán (FML); Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre (MCN); Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP); Museu Nacional, Rio de Janeiro (MNRJ); Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP); Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS). Other abbreviations used in the text: head length (HL), standard lenght (SL), material not catalogued (uncat.).

Results

Trichomycterus sp. n. A, new species

Figs. 1-7, Table 1

Holotype. UFRGS uncat., 82.0 mm SL, Brazil, State of Rio Grande do Sul, Municipality of São Francisco de Paula, rio Santa Cruz, rio Caí basin, 29°21'46"S 50°31'18"W, 11 Sep 2004, G. N. Silva, J. A. Anza, J. Ferrer & L. R. Malabarba.

Paratypes. All from Brazil, State of Rio Grande do Sul. **Rio Caí basin:** UFRGS 6831, 14 (2 c&s), 27.3-87.5 mm SL, collected with the holotype. UFRGS 6829, 3 (1 c&s), 35.2-67.2 mm SL, Municipality of São Francisco de Paula, arroio Cará, 29º14'42"S 50º37'46"W, 12 Sep 2004, G. N. Silva, J. A. Anza, J. Ferrer & L. R. Malabarba. MCN uncat., 5, 32.1-56.7 mm SL, Municipality of Canela, arroio Saiqui, 29º18'32"S 50º45'41"W, 19 Sep 2006, R. B. Dala-Corte. MCP uncat., 2 (1 c&s), 32.7-81.8 mm SL, Municipality of São Francisco de Paula, arroio Lava-Pés, 29º12'49"S 50º44'59"W, 30 Mar 2002, V. A. Bertaco & V. C. Baumbach. **Rio Taquari-Antas basin:** MCN 14879, 1, 74.6 mm SL, Municipality of Bom Jesus, arroio do Barreiro, 10 Jul 1997, L. F. Guterrez & W. R. Koch. MCN 14907, 1, 78.7 mm SL, Municipality of São Francisco de Paula, rio Tomé, 11 Jul 1997, L. F. Guterrez & W. R. Koch. MCP 26920, 2, 27.6-79.6 mm SL, Municipality of São Francisco de Paula, rio Contendas, 29º17'S 50º16'W, 2 May 1998, G. Vinciprova & W. Bruschi. MCP 35064, 3 (1 c&s), 33.0-71.0 mm SL, Municipality of Lagoa Vermelha, rio Turvo, 28º24'19"S 51º29'25"W, 22 May 2004, A. M. Liedke, E. H. Pereira, T. P. Carvalho & R. E. Reis. MCP 42790, 7, 49.0-80.0 mm SL, Municipality of Bom Jesus, arroio Bagual, 28º43'32"S 50º43'44"W, 18 Apr 2008, B. B. Calegari, E. H. Pereira & J. F. P. Silva. MCP 42794, 2, 35.3-80.8 mm SL, Municipality of Bom Jesus, arroio Governador, 28º47'42"S 50º42'18"W, 17 Apr 2008, B. B. Calegari, E. H. Pereira & J. F. P. Silva. MCP uncat., 1, 79.0 mm SL, Municipality of São Francisco de Paula, rio Lageado Grande, 29º13'26"S 50º28'14"W, 16 Dec 1998, A. R. Cardoso, F. Melo, P. A. Buckup & R. E. Reis. MCP uncat., 7 (2 c&s), 41.7-79.3 mm SL, Municipality of São Francisco de Paula, rio Contendas, 29º16'45"S 50º14'43"W, 3 Feb 2007, C. A. Cramer, E. H. Pereira, T. P.

Carvalho & R. E. Reis. MCP uncat., 3, 63.2-85.8 mm SL, Municipality of Bom Jesus, arroio Governador, 28º44’23”S 50º40’42”W, 18 Apr 2008, B. B. Calegari, E. H. Pereira & J. F. P. Silva. MNRJ uncat., 1, 72.9 mm SL, Municipality of São Francisco de Paula, unnamed stream tributary of rio Tainhas on road RS-453, 29º15’45”S 50º19’55”W, 16 Dec 1998, A. R. Cardoso, F. Melo, P. A. Buckup & R. E. Reis. UFRGS 5570, 4 (1 c&s), 44.3-73.1 mm SL, Municipality of Cambará do Sul, unnamed stream tributary of rio Camisas, 29º03’54”S 50º09’39”W, 1 Apr 2001, J. A. Anza, J. R. Bastos, L. R. Malabarba & T. O. B. Hasper. UFRGS 5571, 1, 50.9 mm SL, Municipality of Bom Jesus, arroio das Nevilhas, 28º57’12”S 50º29’03”W, 31 Mar 2001, J. A. Anza, J. R. Bastos, L. R. Malabarba & T. O. B. Hasper. UFRGS 6911, 3, 48.4-78.1 mm SL, Municipality of Cambará do Sul, unnamed stream tributary of rio Tainhas, 29º15’06”S 50º16’39”W, 27 Nov 2004, A. B. Schaan, G. N. Silva, J. A. Anza & V. Lampert. UFRGS uncat., 2, 84.4-91.7 mm SL, Municipality of São Francisco de Paula, unnamed stream tributary of rio Tainhas, 29º15’47”S 50º19’56”W, 30 Mar 2001, J. A. Anza, J. R. Bastos, L. R. Malabarba & T. O. B. Hasper. UFRGS uncat., 11 (2 c&s), 45.3-90.3 mm SL, Municipality of Vacaria, unnamed stream tributary of rio Quebra-Dentes, 28º33’42”S 50º54’32”W, 10 Nov 2009, C. E. Machado & J. A. Anza. UFRGS uncat., 4 (2 c&s), 46.4-66.3 mm SL, Municipality of Vacaria, arroio Maria Inácia, rio Quebra-Dentes basin, 28º27’52”S 51º02’W, 2 Jun 2010, F. G. Becker, G. Rosa & L. De Fries. UFRGS uncat., 3, 42.4-92.4 mm SL, Municipality of Monte Alegre dos Campos, arroio dos Cães, rio Quebra-Dentes basin, 28º39’26”S 50º49’06”W, 1 Jun 2010, F. G. Becker, G. Rosa & L. De Fries. UFRGS uncat., 5, 55.4-86.5 mm SL, Municipality of Vacaria, unnamed stream tributary of rio Quebra-Dentes, 28º38’36”S 50º50’06”W, 10 Nov 2009, C. E. Machado & J. A. Anza. UFRGS uncat., 3 (1 c&s), 47.1-81.9 mm SL, Municipality of São Marcos, unnamed stream near to Molin waterfall, tributary of arroio São Marcos, 29º02’35”S 51º01’29”W, F. G. Becker, G. Rosa & L. De Fries. UFRGS uncat., 2, 40.3-78.3 mm SL, Municipality of São Francisco de Paula, rio Buriti, 29º09’40”S 50º32’37”W, 31 Mar 2001, J. A. Anza, J. R. Bastos, L. R. Malabarba & T. O. B. Hasper. UFRGS uncat., 3, 42.3-73.8 mm SL, Municipality of São Francisco de Paula, arroio Ribeirão, 29º13’59”S 50º22’30”W, 29 Nov 2004, A. B. Schaan, G. N. Silva, J. A. Anza & V. Lampert. UFRGS uncat., 5 (1 c&s), 43.8-66.0 mm SL, Municipality of Cambará do Sul,

unnamed stream tributary of rio Camisas, 29º10'45"S 50º08'13"W, 27 Nov 2004, A. B. Schaan, G. N. Silva, J. A. Anza & V. Lampert.

Diagnosis. *Trichomycterus* sp. n. A is distinguishable from its congeners in the southeast and southern Brazil [except *T. davisi* (Haseman, 1911); *T. papilliferus* Wosiacki & Garavello, 2004; *T. plumbeus* Wosiacki & Garavello, 2004; *T. tropeiro*; and *Trichomycterus* sp. n. B] by the number of pectoral-fin rays (I+6, one specimen of 102 with I+7) and the first ray of pectoral fin not prolonged as filament [*vs.* I+5 pectoral-fin rays in *T. mboycy* Wosiacki & Garavello, 2004; *T. naipi* Wosiacki & Garavello, 2004; *Trichomycterus* sp. n. C, and *Trichomycterus* sp. n. D; *vs.* I+7 or more pectoral-fin rays in *T. castroi* de Pinna 1992; *T. diabolus* Bockmann, Casatti & de Pinna, 2004; *T. guaraquessaba* Wosiacki, 2005; *T. igobi* Wosiacki & de Pinna, 2008; *T. iheringi* (Eigenmann, 1917); *T. santaeritae* (Eigenmann, 1918); *T. stawiarski* (Miranda-Ribeiro, 1968); and *T. tupinamba* Wosiacki & Oyakawa, 2005; *vs.* first ray of pectoral fin prolonged as filament in *T. albinotatus* Costa, 1992; *T. alternatus* (Eigenmann, 1917); *T. auroguttatus* Costa, 1992; *T. brasiliensis* Lütken, 1874; *T. brunoi* Barbosa & Costa, 2010; *T. caipora* Lima, Lazzarotto & Costa, 2008, *T. candidus* (Miranda-Ribeiro, 1949); *T. caudofasciatus* Alencar & Costa, 2004; *T. claudiae* Barbosa & Costa, 2010; *T. concolor* Costa, 1992; *T. crassicaudatus* Wosiacki & de Pinna, 2008; *T. fuliginosus* Barbosa & Costa, 2010; *T. giganteus* Lima & Costa, 2004; *T. goeldii* Boulenger, 1896; *T. immaculatus* (Eigenmann & Eigenmann, 1889); *T. itacambariensis* Trajano & de Pinna, 1996; *T. itacambirussu* Triques & Vono, 2004; *T. itatiayae* Miranda-Ribeiro, 1906; *T. jacupiranga* Wosiacki & Oyakawa, 2005; *T. jequitinhonhae* Triques & Vono, 2004; *T. landinga* Triques & Vono, 2004; *T. longibarbatus* Costa, 1992; *T. macrotrichopterus* Barbosa & Costa, 2010; *T. maculosus* Barbosa & Costa, 2010; *T. maracaya* Bockmann & Sazima, 2004; *T. mariamole* Barbosa & Costa, 2010; *T. mimonha* Costa, 1992; *T. mirissumba* Costa, 1992; *T. nigricans* Valenciennes, 1832; *T. nigroauratus* Barbosa & Costa, 2008; *T. novalimensis*, Barbosa & Costa, 2010; *T. pantherinus* Alencar & Costa, 2004; *T. paolence* (Eigenmann, 1917); *T. paquequerense* (Miranda-Ribeiro, 1943); *T. pauciradiatus* Alencar & Costa, 2006; *T. potschi* Barbosa & Costa, 2003; *T. reinhardti* (Eigenmann, 1917); *T. rubiginosus* Barbosa & Costa, 2010; *T. taroba* Wosiacki & Garavello, 2004; *T. trefauti* Wosiacki, 2004; *T. triguttatus* (Eigenmann, 1918); *T. variegatus* Costa, 1992; *T. vermiculatus* (Eigenmann,

1917); and *T. zonatus* (Eigenmann, 1918)]. Distinguished from *T. davisi* by the presence of up to four rows of teeth in the lower jaw and maxilla (*vs.* two rows), length of posterior process of autopalatine (extending to half length of metaperygoid *vs.* extending to anterior margin of metaperygoid). Distinguished from *T. papilliferus*, *T. plumbeus*, and *Trichomycterus* sp. n. B by color pattern of flank and dorsum with irregular rounded black spots (*vs.* flank and dorsum of body gray in *T. papilliferus* and *T. plumbeus*; flank with irregular dark blotches progressively joined dorsally, progressively larger and joined dorsally and forming extended black pigmented regions with light yellow gaps in *Trichomycterus* sp. n. B). Distinguished from *T. tropeiro* by the presence of pelvic girdle and pelvic fins (*vs.* absence); absence of pores i1 and i3 of infraorbital sensory canal (*vs.* presence). Additionally, *Trichomycterus* sp. A distinguished from remaining species from laguna dos Patos system by number of teeth (36-39) in ceratobranchial 5 (*vs.* 12-13 in *Trichomycterus* sp. n. B and 20-23 in *Trichomycterus* sp. n. C); number of teeth (35-40) in pharyngobranchial 4 (*vs.* 18-20 in *Trichomycterus* sp. B and 23-25 in *Trichomycterus* sp. n. A); color pattern of flank and dorsum of body with irregular rounded black spots [*vs.* flank and dorsum of body dark brown mottled over a light yellow background may present two stripes (midlateral and ventrolateral) with notched borders in *Trichomycterus* sp. n. C; flank and dorsum of body dark brown mottled over a light yellow background in *Trichomycterus* sp. n. D]. *Trichomycterus* sp. n. A is further distinguishable from *Trichomycterus* sp. n. C by origin of dorsal fin at vertical through the last third of pelvic fins (*vs.* at vertical through between tip of pelvic fins and anterior insertion of anal fin). *Trichomycterus* sp. n. A is further distinguishable from *Trichomycterus* sp. n. D by posterior cranial fontanel extended from the supraoccipital to the frontals (*vs.* posterior cranial fontanel restricted to supraoccipital); maxillary barbel length (37.8-66.6 *vs.* 68.2-87.7 mm HL), number of odontodes of opercular patch (13-19 *vs.* 8-11). *Trichomycterus* sp. n. A is further distinguishable from *Trichomycterus* sp. n. B by insertion of first one dorsal-fin pterygiophore anterior to neural spine of 19th to 22th vertebrae (*vs.* anterior to neural spine of 17th to 18th vertebrae).

Description. Morphometric data for holotype and paratypes given in Table 1. Body elongate, trunk roughly cylindrical and gradually compressed towards caudal fin. Dorsal

profile of trunk convex in first half length, and then straight to insertion of dorsal fin. Ventral profile of trunk straight to slightly convex. Dorsal and ventral profile of caudal peduncle straight to slightly concave.

Head depressed, trapezoidal in dorsal view, wider posteriorly. Dorsal profile straight and ventral profile straight to slightly convex. Snout rounded in dorsal view. Eyes readily visible, elliptical anteroposteriorly to rounded, dorsally oriented; orbital rim not free, eyes covered with skin thin and transparent. Each eye located over posterior termination of shallow and small longitudinal crest beginning in posterior nostril making eyes visible in lateral view.

Nostrils with same size, smaller than diameter of eye. Anterior nostril surrounded by fleshy flap of integument, posterolaterally continuous with nasal barbel. Posterior nostril surrounded anterolaterally by thin flap of integument. Gill openings not constricted, united with isthmus anteriorly forming a free fold. Mouth subterminal, its corners posteriorly oriented. Lower lip with conspicuous fleshy lobes along lateral limits and internal to origin of rictal barbels. Lips with small papillae, largest on inner surface of upper lip.

Barbels with large bases and tapering gradually toward to tip. Tip of nasal barbel usually reaching between the eye and the pore i11, at most slightly surpassing the pore i11. Origin of nasal barbels on posterolateral portion of integument flap around anterior nostril. Maxillary barbel usually extending between anterior tip of interopercular patch of odontodes and its posterior tip, at most slightly surpassing the posterior tip, never reaching the pectoral-fin insertion. Rictal barbell slightly shorter than maxillary barbel.

Pectoral fin with distal margin rounded, I+6* rays (one specimen with I+7) (n = 102), the first ray short, not prolonged as filament. Dorsal fin with distal margin rounded, semicircular when fin expanded, two to four unsegmented rays (n = 14), II+5-8 rays (n = 102), usually II+7*, origin at vertical through the last third of pelvic fins. Anal fin slightly smaller than dorsal fin, with distal margin rounded, two to four unsegmented rays (n = 14), II+4-6 rays, usually II+5* (n = 102), origin at vertical through the middle length of dorsal-fin base. Pelvic fin with distal margin rounded reaching, at most the anterior margin of urogenital papilla, I+4 rays (n = 102). Inner margin of pelvic fins very close near their base. Urogenital papilla nearer tip of pelvic fins than origin of anal fin.

Pelvic girdle with two basipterygium united medially by cartilage with two bifid processes elongate (external process and internal process) and medial process short (one of 14 specimens with medial process united to internal process). Pelvic splint thin with comma-shaped, parallel to first pelvic ray.

Caudal fin with distal margin straight and dorsal and ventral edges rounded, procurrent caudal-fin rays 14-17 dorsally (n = 14) and 10-13 ventrally (n = 14), I+5+6+I* principal rays (one specimen with I+5+7+I) (n = 102), branched rays splitting twice or thrice. Lower caudal plate with parhypural and hypurals 1 and 2 co-ossified and fused to compound caudal centrum. Upper caudal plate with hypurals 3, 4 and 5 completely fused (n = 3) (Fig. 2) or with hypural 3 autogenous (n = 8) or partly fused (n = 3) with hypurals 4 and 5 (Fig. 3); and uroneural.

Vertebrae 38-41 (n = 14), ribs 12-15 (n = 14), first rib straight and thickest, last rib rudimentary. Dorsal-fin pterygiophores 8 (n = 14), first one inserting anterior to neural spine of 19th to 22th vertebrae. Anal-fin pterygiophores 6 (n = 14), first one inserting anterior to hemal spine 22th to 25th vertebrae.

Mesethmoid with anterior margin slightly concave, cornuas short and thick, width of their bases similar to their length (Fig. 4). Anterior cranial fontanel restricted to small and rounded opening situated between frontals and epiphyseal bar. Posterior cranial fontanel long and narrow extending from posterior portion of frontals to supraoccipital. Epiphyseal bar longer than wide (absent in one of 14 specimens). Antorbital short and anteriorly expanded. Tendon-bone supraorbital elongate, approximately three times larger than antorbital, with a process in distal margin. Anterior portion of sphenotic laterally directed in dorsal view. Sphenotic, prootic, and pterosphenotic entirely fused to each other. Vomer arrow-shaped, with long posterior process extending to parasphenoid. Parasphenoid with long and pointed process extending to basioccipital. Anterior portion of Weberian complex fused to basioccipital. Weberian capsule with lateral opening smaller than lateral profile of capsule.

Premaxilla rectangular with 75-101 conical, curved, and pointed teeth (n = 2), variable in size, distributed with some irregularities in up to four rows. Maxilla large, boomerang-shaped, shorter than premaxilla. Lower jaw with 89-107 conical, curved, and pointed teeth (n = 2), outer rows of teeth slightly flat vertically with blunt tips in largest specimens (>

85.4 mm SL), variable in size, few teeth at base of coranoid process to four discernible rows near dentary symphysis. Autopalatine with anterior margin straight, mesial margin straight to slightly concave, distal margin slightly concave, and large posterior process extending to half length of metaperygoid.

Metapterygoid large and laminar connecting with quadrate through cartilage. Hyomandibula well-developed. Preopercle long and narrow, in contact with ventral margins of both quadrate and hyomandibula. Opercular patch of odontodes rounded with 13-19 conical odontodes (n = 14). Interopercular patch of odontodes elongate with 15-25 conical odontodes (n = 14), more concentrated in posterior portion. Odontodes of both opercular and interopercular patches gradually curving medially and increasing in size towards posterior portion.

Hyoid arch with trapezoid-shaped ventral hypohyal (Fig. 5). Anterior ceratohyal elongate widening at tips, posterior ceratohyal short and triangle-shaped, cartilage between bones with length and wide approximately equal. Branchiostegal rays 8-9 (n = 14), usually 9, five articulated in ceratohyal anterior, one articulated in ceratohyal posterior and three articulated in cartilage between these bones. Last three branchiostegal rays wider than anterior ones. Dorsal hypohyal and interhyal absent. Urohyal with expanded anterior head, two elongate processes with wide bases, decreasing distally and bearing rounded tips; and laminar, elongate and narrow posterior process (Fig. 6).

Basibranchial 1 absent. Basibranchials 2 and 3 connected to each other with approximately equal lengths and cartilage at their tips (Fig. 7). Ossified portion of basibranchial 2 distinctly wider than basibranchial 3. Basibranchial 4 completely cartilaginous with hexagon-shaped. Hypobranchial 1 with similar size to basibranchial 2, however narrower, with cartilage in their tips. Hypobranchials 2 and 3 with reduced portion ossified located lateroanteriorly, more elongate in hypobranchial 3; and large area of cartilage, larger in hypobranchial 3. Hypobranchial 4 absent. Five elongate and narrow ceratobranchials with cartilage in their tips. Ceratobranchials 2 and 3 with concavity at its posterior margin, larger in ceratobranchial 3. Ceratobranchial 5 expanded posteromedially with 36-39 conical, elongate and pointed teeth located dorsally, arranged in up to 3 rows (n = 1). Five epibranchials, first three elongate and narrow with cartilage in their tips. Epibranchials 1 and 2 with triangle-shaped process at its anterior margin, slightly larger in epibranchial 1.

Epibranchial 3 with robust uncinate process at its posterior margin. Epibranchial 4 with rectangular aspect. Epibranchial 5 small, narrow, and curved, completely cartilaginous. Pharyngobranchials 1 and 2 absent. Pharyngobranchial 3 similar to hypobranchial 1, however shorter, with cartilage in their tips. Pharyngobranchial 4 curved and well ossified connected to a plate with 35-40 conical, elongate and pointed teeth, arranged in up to three rows, growing in length anteroposteriorly (n = 1).
Head sensory canals with simple (non-dendritic) tubes ending in single pores (Fig. 4). Supraorbital sensory canal complete with pores paired s1, s3 and s6. Pores s1 located between anterior nostrils, pores s3 located in same longitudinal row of pores s1 after posterior nostrils and pores s6 in interorbital space. Infraorbital sensory canal incomplete; pores i1 and i3 absent; pores i10, located behind the eye; and pores i11, located laterally to posterior margin of eye. Pos-otic pores po1, located laterally to anterior margin of opercular patch of odontodes; and po2, located laterally to middle length of opercular patch of odontodes. Lateral-canal very short with 2 pores, located above insertion of pectoral fins and just after gill openings.

Coloration in alcohol. Flank and dorsum of body with irregular black spots rounded variable in size in a light yellowish background, more concentrated in dorsum (Fig. 1). Ventral surface of body light yellow with diffuse and small black spots on laterals and between pectoral fins insertion, larger and more concentrated between pelvic and anal fins and caudal peduncle. Dorsal surface of head with great concentration of irregular black spots rounded variable in size, becoming more scattered on lateral surface, ventrally smaller and restricted to laterals and posterior margin of gill openings. Pectoral, dorsal, anal, and caudal fins spotted on basal portion, becoming inconspicuous toward to tips, and edges lighter. Pelvic fin unpigmented. Barbels with dark pigmentation on both surfaces. Some larger specimens with small spots on outer skin layer of caudal peduncle and dorsum.

Distribution and ecological notes. *Trichomycterus* sp. n. A is distributed in the upper portions of the rio das Antas and rio Caí tributaries, laguna dos Patos system (Fig. 8). The type locality is located in an altitude of approximately 792 m and the remaining types between 681 and 941 m asl. The localities where the types were collected possess clear and

current water and rocky bottom (Fig. 9). *Trichomycterus* sp. n. A was collected with *Cnesterodon brevirostratus* Rosa & Costa, 1993; *Pareiorhaphis hystrix* (Pereira & Reis, 2002); and *Bryconamericus patriciae* Silva, 2004 at the type locality, corresponding to species that shoe some degree of endemism on the region related to high altitudes. The stomach of 13 c&s specimens contained larvae of Chironomidae, Lepidoptera, Simuliidae, and Trichoptera; and nymphs of Ephemeroptera and Plecoptera.

***Trichomycterus* sp. n. B, new species**
Figs. 10-17, Table 2

Holotype. MCP uncat., 58.8 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Nova Prata, rio da Prata on Passo do Despraiado, 28°38'04"S 51°36'53"W, 22 May 2004, A. M. Liedke, E. H. Pereira, R. E. Reis & T. P. Carvalho.

Paratypes. All from Brazil, State of Rio Grande do Sul, rio Taquari-Antas basin. MCP 35050, 9 (1 c&s), 21.6-58.2 mm SL, collected with the holotype. MCP 22203, 4 (1c&s), 57.4-68.3 mm SL, collected at type locality, 20 Jan 1999, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP 40933, 7 (2 c&s), 30.7-39.7 mm SL, collected at type locality, 24 Out 2006, T. P. Carvalho & V. A. Bertaco. MCP 22789, 2, 39.1-57.1 mm SL, Municipality of Lagoa Vermelha, arroio Carazinho, rio Turvo basin, 28º17'36"S 51º24'42"W, 3 Apr 1999, E. H. Pereira, R. E. Reis & V. A. Bertaco. MCP 40940, 2, 47.9-67.0 mm SL, Municipality of André da Rocha, arroio Herval, rio da Prata basin, 28º39'32"S 51º37'03"W, 24 Out 2006, T. P. Carvalho & V. A. Bertaco.

Non-type material. MCP 22785, 1, 59.1 mm SL, Municipality of Muitos Capões, arroio Espeto, rio Turvo basin, 28º23'26"S 51º03'22"W, 3 Apr 1999. E. H. Pereira, R. E. Reis & V. A. Bertaco.

Diagnosis. *Trichomycterus* sp. n. B is distinguishable from its congeners in the southeast and southern Brazil (except *T. davisi*, *T. papilliferus*, *T. plumbeus*, *T. tropeiro*, and *Trichomycterus* sp. n. A) by the number of pectoral-fin rays (I+6) and the first ray of

pectoral fin not prolonged as filament (*vs.* I+5 pectoral-fin rays in *T. mboycy*, *T. naipi*, *Trichomycterus* sp. n. C, and *Trichomycterus* sp. n. D; *vs.* I+7 or more pectoral-fin rays in *T. castroi*, *T. diabolus*, *T. guaraquessaba*, *T. igobi*, *T. iheringi*, *T. santaeritae*, *T. stawiarski*, and *T. tupinamba*; *vs.* first ray of pectoral fin prolonged as filament in *T. albinotatus*, *T. alternatus*, *T. auroguttatus*, *T. brasiliensis*, *T. brunoi*, *T. caipora*, *T. candidus*, *T. caudofasciatus*, *T. claudiae*, *T. concolor*, *T. crassicaudatus*, *T. fuliginosus*, *T. giganteus*, *T. goeldii*, *T. immaculatus*, *T. itacambariensis*, *T. itacambirussu*, *T. itatiayae*, *T. jacupiranga*, *T. jequitinhonhae*, *T. landinga*, *T. longibarbatus*, *T. macrotrichopterus*, *T. maculosus*, *T. maracaya*, *T. mariamole*, *T. mimonha*, *T. mirissumba*, *T. nigricans*, *T. nigroauratus*, *T. novalimensis*, *T. pantherinus*, *T. paolence*, *T. paquequerense*, *T. pauciradiatus*, *T. potschi*, *T. reinhardti*, *T. rubiginosus*, *T. taroba*, *T. trefauti*, *T. triguttatus*, *T. variegatus*, *T. vermiculatus*, and *T. zonatus*). Distinguished from *T. davisi*, *T. papilliferus*, *T. plumbeus*, *T. tropeiro*, and *Trichomycterus* sp. n. A by the color pattern with irregular dark blotches progressively joined dorsally, progressively larger and joined dorsally and forming extended black pigmented regions with light yellow gaps (*vs.* head and trunk with black spots scattered in *T. davisi*; flank and dorsum of body gray in *T. papilliferus* and *T. plumbeus*; flank and dorsum with irregular black spots in *T. tropeiro* and *Trichomycterus* sp. n. A). Additionally, *Trichomycterus* sp. n. B is distinguished from remaining species from laguna dos Patos system by the color pattern with irregular dark blotches progressively joined dorsally, progressively larger and joined dorsally and forming extended black pigmented regions with light yellow gaps [*vs.* flank and dorsum of body dark brown mottled over a light yellow background may present two stripes (midlateral and ventrolateral) with notched borders in *Trichomycterus* sp. n. C; flank and dorsum of body dark brown mottled over a light yellow background in *Trichomycterus* sp. n. D]. *Trichomycterus* sp. n. B is further distinguishable from *Trichomycterus* sp. n. C by origin of dorsal fin at vertical through the last third of pelvic fins (*vs.* at vertical through between tip of pelvic fins and anterior insertion of anal fin), origin of anal fin at vertical through base of last dorsal-fin ray (*vs.* at vertical through between anterior insertion of dorsal fin and the half of its length). *Trichomycterus* sp. n. B is further distinguishable from *Trichomycterus* sp. n. D by posterior cranial fontanel extended from the supraoccipital to the frontals (*vs.* posterior cranial fontanel restricted to supraoccipital); maxillary barbel not surpassing the

posterior tip of interopercular patch of odontodes (*vs.* surpassing posterior tip of interopercular patch of odontodes, usually, reaching or surpassing pectoral fin insertion); number of odontodes of opercular patch (13-19 *vs.* 8-11). *Trichomycterus* sp. n. B is further distinguishable from *Trichomycterus* sp. n. A by insertion of first one dorsal-fin pterygiophore (anterior to neural spine of 17th to 18th vertebrae *vs.* anterior to neural spine of 19th to 22th vertebrae); number of teeth in ceratobranchial 5 and pharyngobranchial 4 (12-13 *vs.* 36-39 and 18-20 *vs.* 35-40, respectively). *Trichomycterus* sp. n. B is further distinguishable from *T. tropeiro* by the presence of pelvic girdle and pelvic fins (*vs.* absence); insertion of first one dorsal-fin pterygiophore (anterior to neural spine of 17th to 18th vertebrae *vs.* anterior to neural spine of 19th to 20th vertebrae), and alternative presence or absence of pores i1 and i3 of infraorbital sensory canal (*vs.* always present).

Description. Morphometric data for holotype and paratypes given in Table 2. Body elongate, trunk roughly cylindrical and gradually compressed towards caudal fin. Dorsal profile of trunk convex in first half length, and then straight to insertion of dorsal fin. Dorsal profile of caudal peduncle straight to slightly convex. Ventral profile of trunk and caudal peduncle nearly straight.

Head depressed, trapezoidal in dorsal view, wider posteriorly. Dorsal profile straight and ventral profile straight to slightly convex. Snout rounded in dorsal view. Eyes readily visible, elliptical anteroposteriorly and dorsally oriented; orbital rim not free, eyes covered with skin thin and transparent. Each eye located over posterior termination of small longitudinal ridge beginning in posterior nostril making eyes fully visible in lateral view. Nostrils with same size, smaller than diameter of eye. Anterior nostril surrounded by fleshy flap of integument, posterolaterally continuous with nasal barbel. Posterior nostril surrounded anterolaterally by thin flap of integument. Gill openings not constricted, united with isthmus anteriorly forming a large free fold. Mouth subterminal, its corners posteriorly oriented. Lower lip with conspicuous fleshy lobes along lateral limits and internal to origin of rictal barbels. Lips with small papillae, largest on inner surface of upper lip.

Barbels with large bases and tapering gradually toward to tip. Tip of nasal barbel usually reaching between the eye and the pore i11, at most slightly surpassing the pore i11. Origin of nasal barbels on posterolateral portion of integument flap around anterior nostril.

Maxillary barbel usually extending between anterior tip of interopercular patch of odontodes and its half length, never reaching its posterior tip. Rictal barbell slightly shorter than maxillary barbel.

Pectoral fin with distal margin truncate to slightly rounded, I+6 rays (n = 25), the first ray short, not prolonged as filament. Dorsal fin with distal margin rounded, semicircular when fin expanded, two unsegmented rays (n = 4), II+6-8 rays (n = 25), usually II+7*, origin at vertical through the last third of pelvic fins. Anal fin slightly smaller than dorsal fin, with distal margin rounded, two or three unsegmented rays (n = 4), II+5 (n = 25), origin at vertical through base of last dorsal-fin ray. Pelvic fin with distal margin rounded reaching, at most the anterior margin of urogenital papilla, I+4* rays (one specimen with I+3) (n = 25). Inner margin of pelvic fins very close near their base, sometimes in contact. Urogenital papilla nearer tip of pelvic fins than origin of anal fin. Pelvic girdle with two basipterygium united medially by cartilage with two bifid processes elongate (external process and internal process) and medial process short (Fig. 11). Pelvic splint thin with comma-shaped, parallel to first pelvic ray.

Caudal fin with distal margin straight and dorsal and ventral edges rounded, procurrent caudal-fin rays 15-16 dorsally (n = 4) and 10-12 ventrally (n = 4), I+5+6+I principal rays (n = 18), branched rays splitting twice or thrice. Lower caudal plate with parhypural and hypurals 1 and 2 co-ossified and fused to compound caudal centrum (Fig. 12). Upper caudal plate with hypural 3 autogenous, hypurals 4 and 5 fused to each other, and uroneural.

Vertebrae 36-38 (n = 4), ribs 12-13 (n = 4), first rib straight and thickest, last rib rudimentary. Dorsal-fin pterygiophores 8 (n = 4), first one inserting anterior to neural spine of 17th or 18th vertebrae. Anal-fin pterygiophores 6 (n = 4), first one inserting anterior to hemal spine 21th or 22th vertebrae.

Mesethmoid with anterior margin slightly concave, cornuas short and thick, width of their bases similar to their length (Fig. 13). Anterior cranial fontanel restricted to small and rounded opening situated between frontals and epiphyseal bar. Posterior cranial fontanel long and narrow extending from posterior portion of frontals to supraoccipital. Epiphyseal bar longer than wide. Antorbital short and anteriorly expanded. Tendon-bone supraorbital elongate, approximately three times larger than antorbital. Anterior portion of sphenotic

anterolaterally directed in dorsal view. Sphenotic, prootic, and pterosphenotic entirely fused to each other. Vomer arrow-shaped, with long posterior process extending to parasphenoid. Parasphenoid with long and pointed process extending to basioccipital. Anterior portion of Weberian complex fused to basioccipital. Weberian capsule with lateral opening smaller than lateral profile of capsule.

Premaxilla rectangular with 103 conical, curved and pointed teeth (n = 1), variable in size, distributed with some irregularities in up to three rows. Maxilla large, boomerang-shaped, shorter than premaxilla. Lower jaw with 75 conical to slightly flat vertically, curved and pointed teeth (n = 1), variable in size, few teeth at base of coranoid process to three discernible rows near dentary symphysis (Fig. 14). Autopalatine with anterior margin convex, mesial margin concave, distal margin slightly concave and small posterior process extending slightly over the metapterygoid.

Metapterygoid large and laminar connecting with quadrate through cartilage. Hyomandibula well-developed. Preopercle long and narrow, in contact with ventral margins of both quadrate and hyomandibula. Opercular patch of odontodes rounded with 13-19 conical odontodes (n = 4). Interopercular patch of odontodes elongate with 20-23 conical odontodes (n = 4), more concentrated in posterior portion. Odontodes of both opercular and interopercular patches gradually curving medially and increasing in size towards posterior portion.

Hyoid arch with trapezoid-shaped ventral hypohyal (Fig. 15). Anterior ceratohyal elongate widening at tips, posterior ceratohyal short and triangle-shaped, cartilage between bones with length and wide approximately equal. Nine branchiostegal rays (n = 4), five in ceratohyal anterior, one in ceratohyal posterior and three in cartilage between these bones. Last three branchiostegal rays wider than anterior ones. Dorsal hypohyal and interhyal absent. Urohyal with expanded anterior head, two elongate processes with wide bases, decreasing distally and bearing rounded tips; and laminar, elongate and narrow posterior process (Fig. 16).

Basibranchial 1 absent. Basibranchials 2 and 3 connected to each other with approximately equal lengths and cartilage at their tips (Fig. 17). Ossified portion of basibranchial 2 distinctly wider than basibranchial 3. Basibranchial 4 completely cartilaginous with hexagon-shaped. Hypobranchial 1 with similar size to basibranchial 2, however narrower,

with cartilage in their tips. Hypobranchials 2 and 3 with reduced portion ossified located lateroanteriorly, more elongate in hypobranchial 3; and large area of cartilage, larger in hypobranchial 3. Hypobranchial 4 absent. Five elongate and narrow ceratobranchials with cartilage in their tips. Ceratobranchial 3 with concavity at posterior margin. Ceratobranchial 5 expanded posteromedially with 12-13 conical, elongate and pointed teeth located dorsally, arranged in 2 rows (n = 1). Five epibranchials, first three elongate and narrow with cartilage in their tips. Epibranchials 1 and 2 with triangle-shaped process at its anterior margin. Epibranchial 3 with robust uncinate process at its posterior margin. Epibranchial 4 with rectangular aspect. Epibranchial 5 small and narrow with curved aspect, completely cartilaginous. Pharyngobranchials 1 and 2 absent. Pharyngobranchial 3 similar to hypobranchial 1, however shorter, with cartilage in their tips. Pharyngobranchial 4 curved and well ossified connected to a plate with 18-20 conical, elongate and pointed teeth, arranged in two rows, growing in length anteroposteriorly (n = 1).
Head sensory canals with simple (non-dendritic) tubes ending in single pores (Fig. 13). Supraorbital sensory canal complete with pores paired s1, s3 and s6. Pores s1 located between anterior nostrils, pores s3 located in same longitudinal row of pores s1 after posterior nostrils and pores s6 in interorbital space. Infraorbital sensory canal incomplete; presence of pores i1 and i3 variable (present in 8 specimens, including the holotype, and absent in 17 specimens); when present located beside nostrils; pores i10, located behind the eye; and pores i11, located laterally to posterior margin of eye. Pos-otic pores po1, located laterally to anterior margin of opercular patch of odontodes, and po2, located laterally to middle length of opercular patch of odontodes. Lateral-canal very short with 2 pores, located above insertion of pectoral fins and just after gill openings.

Coloration in alcohol. Flank of body covered with irregular dark blotches in a light yellow background, progressively larger and joined dorsally and forming extended black pigmented regions with light yellow gaps (Fig. 10). Dorsum of body usually black pigmented with irregular yellow gaps. Ventral surface yellow on trunk with irregular black blotches between pelvic and anal fins and caudal peduncle. Dorsal and lateral surface of head black pigmented with small lighter areas, ventrally yellow. Pectoral, dorsal, anal, and

caudal fins spotted with irregular black marks and lighter on edges. Pelvic fin unpigmented. Barbels with dark pigmentation dorsally and yellow ventrally.

Distribution and ecological notes. *Trichomycterus* sp. n. B is apparently endemic to the rio da Prata and rio Turvo basins, tributaries of rio das Antas, laguna dos Patos system (Fig. 8). The rio da Prata, at the type locality (Fig. 18), is a rapid flow watercourse, wide and shallow, with an average depth of 0.5 m, shallower in most of its extension, with clear water, rocky and large amounts of submersed vegetation (Carvalho & Reis, 2011), upstream to a waterfall known as Cascata da Usina at an altitude of approximately 660 m. At this site *Trichomycterus* sp. n. B occurs sympatric with *Hisonotus prata* Carvalho & Reis, 2011, another endemic species to the rio da Prata. The other two localities of the type specimens are located at altitudes of approximately 642 m and 825 m asl. The stomach of three c&s specimens contained larvae of Chironomidae and Simuliidae and nymphs of Ephemeroptera.

Remarks. The presence of the infraorbital sensory canal is variable among the specimens of *Trichomycterus* sp. n. B, even in specimens of the same lot and with the same size (*e.g.* MCP 40933). Although characters related to the reduction of the sensory canal have been used in defining species and even genera in Trichomycterinae (see Arratia, 1998), there are no additional detectable differences in morphometric and meristic data and in the color pattern among specimens bearing or not the pores i1 and i3 of infraorbital sensory canal to consider two different species. Apparently, this variation in presence of pores i1 and i3 of infraorbital sensory canal is unique in species of *Trichomycterus*. One specimen (MCP 22785) also from rio da Prata basin with counts, morphometrics, and color pattern similar to *Trichomycterus* sp. n. B does not present pelvic fins and was not included in type-series. Definitely, the specimen is not *Trichomycterus tropeiro*, the species that lacks pelvic fins from laguna dos Patos system, and appears to be an anomalous individual of *Trichomycterus* sp. n. B.

***Trichomycterus* sp. n. C, new species**

Figs. 19-26, Table 3

Holotype. UFRGS uncat., 63.3 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Júlio de Castilhos, arroio Passo dos Buracos or Tipiaia on the road BR-158, Alto Jacuí basin, 29°06'50"S 53°39'04"W, 20 May 2011, A. T. Thomaz, F. R. Carvalho, J. Ferrer & L. R. Malabarba.

Paratypes. All from Brazil, State of Rio Grande do Sul. **Alto Jacuí basin.** UFRGS uncat., 10 (3 c&s), 33.1-66.8 mm SL collected with the holotype. UFRGS 11856, 2, 41.4-45.2 mm SL, Municipality of Júlio de Castilhos, unnamed stream tributary of rio Iauí, 29º07'S 53º22'W, 5 Aug 2009, A. R. Cardoso & V. A. Bertaco. UFRGS 14992, 6 (1 c&s), 40.5-92.5 mm SL, Municipality of Cruz Alta, rio Passo Novo, 28º38'43"S 53º33'36"W, 20 May 2011, A. T. Thomaz, F. R. Carvalho, J. Ferrer & L. R. Malabarba. MCP 18253, 1, 65.6 mm SL, Municipality of Faxinal do Soturno, unnamed stream tributary of rio Soturno, 29º25'29"S 53º30'59"W, 28 Jul 1995, G. F. Rey, M. P. Barros & N. F. Fontoura. MCP 21252, 1, 66.9 mm SL, Municipality of Espumoso, unnamed stream on road from Espumoso to Campos Borges, 28º45'51"S 52º55'10"W, 24 Aug 1998, J. F. P. Silva R. E. Reis & V. A. Bertaco. MCP 22127, 1, 43.6 mm SL, Municipality of Santo Antônio do Planalto, rio da Glória, 28º21'02"S 52º43'16"W, 18 Jan 1999, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP 21231, 2, 46.8-54.1 mm SL, Municipality of Agudo, arroio Linha Louca on road to Dona Francisca dam, 29º29'09"S 53º17'09"W, 22 Aug 1998, J. F. P. Silva, R. E. Reis & V. A. Bertaco. MCP 21237, 1, 59.7 mm SL, Municipality of Arroio do Tigre, arroio Tamanduá, 29º16'39"S 53º03'10"W, 24 Aug 1998, J. F. P. Silva R. E. Reis & V. A. Bertaco. MCP 21464, 1, 64.7 mm SL, Municipality of Fortaleza dos Valos, arroio Lajeado Fortaleza, 28º46'45"S 53º11'15"W, 11 Oct 1998, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP 21508, 3, 37.4-59.7 mm SL, Municipality of Fortaleza dos Valos, unnamed stream tributary of rio Lajeado Fortaleza, 28º47'39"S 53º12'17"W, 11 Oct 1998, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP 21522, 1, 64.5 mm SL, Municipality of Fortaleza dos Valos, unnamed stream tributary of rio Ingai, 28º54'29"S 53º17'08"W, 11 Oct 1998, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP 22193, 1, 64.0 mm SL, Municipality of Passo

Fundo, arroio Pinheiro Torto, 28º22’23”S 52º26’38”W, 19 Jan 1999, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP 22778, 1, 54.6 mm SL, Municipality of Santa Bárbara do Sul, arroio das Figueiras on road from Cruz Alta to Saldanha Marinho, 28º26’39”S 53º12’37”W, 2 Apr 1999, E. H. Pereira, R. E. Reis & V. A. Bertaco. MCP 26540, 2, 43.9-56.6 mm SL, Municipality of Agudo, unnamed stream tributary of rio Jacuí, 29º31’38”S 53º16’01”W, 10 Nov 2000, A. R. Cardoso, C. Kaefer, J. F. P. Silva & V. A. Bertaco. MCP 26974, 1, 51.2 mm SL, Municipality of Ibarama, unnamed stream tributary to reservoir of Dona Francisca dam, 2 Feb 2001, R. E. Reis & V. A. Bertaco. MCP uncat., 1, 43.3 mm SL, Municipality of Nicolau Vergueiro, arroio Quebra Dentes, 28º36’09”S 52º27’23”W, 19 Jan 1999, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP uncat., 7 (1c&s), 34.9-61.0 mm SL, Municipality of Nova Jacuí, unnamed stream on road from Estado Velho to Nova Jacuí, 29º06’20”S 53º12’32”W, 11 Oct 1998, E. H. Pereira, J. F. P. Silva & R. E. Reis. MCP uncat., 4 (1 c&s), 29.1-79.0 mm SL, Municipality of Cruz Alta, rio Passo Novo, 28º38’43”S 53º33’35”W, 2 Apr 1999, E. H. Pereira, R. E. Reis & V. A. Bertaco. MCN 16089, 5 (1 c&s), 52.0-60.9 mm SL, Municipality of Estrela Velha, unnamed stream tributary of rio Jacuí, 29º10’20”S 53º09’27”W, 19 Jan 1999, W.R. Koch & C. J. Mansan.

Rio Taquari-Antas basin. UFRGS 13892, 2, 50.6-56.9 mm SL, Municipality of Nova Bassano, arroio Caçador, tributary of rio Carreiro, 28º42’16”S 51º50’38”W, 7 Dec 2010, J. Ferrer & J. M. Wingert. UFRGS 14522, 2 (1 c&s), 59.8-64.2 mm SL, Municipality of Vila Maria, rio Jordão, rio Guaporé basin, 28º32’48”S 52º06’38”W, 13 May 2010, C. Vogel, G. Rosa, L. De Fries & L. Marangon. UFRGS uncat., 2, 39.8-48.3 mm SL, Municipality of Nova Bassano, arroio Caçador, tributary of rio Carreiro, 28º42’16”S 51º50’38”W, 10 Mar 2010, J. Ferrer & J. M. Wingert. UFRGS uncat., 11 (1 c&s), 32.0-74.5 mm SL, Municipality of Nova Alvorada, rio Lajeado Engenho Velho, rio Guaporé basin, 28º39’23”S 52º09’40”W, 14 May 2010, C. Vogel, G. Rosa, L. De Fries & L. Marangon. CIUFSC uncat., 3, 54.5-64.1 mm SL, Municipality of Passo Fundo, unnamed stream at Floresta Nacional of Passo Fundo, 28º18’46”S 52º11’30”W, 24 Nov 2008, B. Marterer. MCP 21203, 1, 51.2 mm SL, Municipality of Soledade, unnamed stream on road from Soledade to Arvorezinha, 28º48’17”S 52º22’20”W, 25 Aug 1998, J. F. P. Silva R. E. Reis & V. A. Bertaco. MCP 22237, 2, 73.4-75.4 mm SL, Municipality of Vila Maria, arroio Porongas, 28º31’34”S 52º08’22”W, 20 Jan 1999, E. H. Pereira, J. F. P. Silva & R. E. Reis.

MCN 15679, 1, 61.0 mm SL, Municipality of Guabiju, arroio Erval on the road between Nova Araça and São Jorge, rio Carreiro basin, 28º33'34"S 51º43'12"W, 16 Apr 1998, W. R. Koch. **Rio Pardo basin.** MCP uncat., 1, 39.6 mm SL, Municipality of Barros Cassal, arroio Pessegueiro on the reservoir of Corsan, rio Pardo basin, 29º05'04"S 52º36'02"W, 08 Dec 2000, J. F. P. Silva & J. R. Marinho.

Non-type material. All from Brazil, State of Rio Grande do Sul. **Rio Taquari-Antas basin.** MCP 35059, 1, 69.2 mm SL, Municipality of Barros Cassal, arroio Fãozinho, 29º03'30"S 52º30'58"W, 21 May 2004, A. M. Liedke, E. H. Pereira, R. E. Reis & T. P. Carvalho. UFRGS 9185, 1, 71.2 mm SL, Municipality of Veranópolis, arroio Jaboticaba, 29º01'12"S 51º31'41"W, 18 Jun 2007, G. N. Silva, J. Ferrer & R. Hirano. UFRGS 13951, 1, 54.6 mm SL, Municipality of Travesseiro, arroio Travesseiro, 29º17'15"S 52º03'37"W, 31 Aug 2007, A. Hirschmann & C. B. Kasper. UFRGS 14228, 2 (1 c&s), 58.8-59.4 mm SL, Municipality of Travesseiro, arroio Travesseiro, 29º17'15"S 52º03'37"W, 1 May 2007, A. Hirschmann & C. B. Kasper. UFRGS uncat., 1, 62.9 mm SL, Municipality of Marquês de Souza, arroio Tamanduá, 29º16'04"S 52º11'W, 13 Feb 2008, A. Hirschmann & C. B. Kasper. UFRGS uncat., 1, 34.3 mm SL, Municipality of Marquês de Souza, arroio Tamanduá, 29º15'44"S 52º08'50"W, 13 Feb 2008, A. Hirschmann & C. B. Kasper. **Rio do Sinos basin.** MCP 26148, 7 (1 c&s), 31.3-57.0 mm SL, Municipality of Igrejinha, arroio Solitária, 29º35'S 50º46'W, 10 Jun 2000, M. Moreira, R. Costa & U. Shultz. MCN 16301, Municipality of Canela, arroio Casca, 29º23'40"S 50º44'50"W, 7 Jun 2000, P.C.C. Milani & P. Marques.

Diagnosis. *Trichomycterus* sp. n. C is distinguishable from its congeners from southeast and southern of Brazil (except *T. mboycy*, *T. naipi*, and *Trichomycterus* sp. n. D) by the number of pectoral-fin rays (I+5, one of 77 specimens with I+6, *vs.* I+6 or more pectoral-fin rays in *T. castroi*, *T. davisi*, *T. diabolus*, *T. guaraquessaba*, *T. igobi*, *T. iheringi*, *T. papilliferus*, *T. plumbeus*, *T. santaeritae*, *T. stawiarski*, *T. tropeiro*, *T. tupinamba*, *Trichomycterus* sp. n. A, and *Trichomycterus* sp. n. B) and by the first ray of pectoral fin not prolonged as filament (*vs.* first ray of pectoral fin prolonged as filament in *T. albinotatus*, *T. alternatus* , *T. auroguttatus*, *T. brasiliensis*, *T. brunoi*, *T. caipora*, *T.*

candidus, *T. caudofasciatus*, *T. claudiae*, *T. concolor*, *T. crassicaudatus*, *T. fuliginosus*, *T. giganteus*, *T. goeldii*, *T. immaculatus*, *T. itacambirussu*, *T. itacambariensis*, *T. itatiayae*, *T. jacupiranga*, *T. jequitinhonhae*, *T. landinga*, *T. longibarbatus*, *T. maculosus*, *T. macrotrichopterus*, *T. maracaya*, *T. mariamole*, *T. mimonha*, *T. mirissumba*, *T. nigricans*, *T. nigroauratus*, *T. novalimensis*, *T. pantherinus*, *T. paolence*, *T. paquequerense*, *T. pauciradiatus*, *T. potschi*, *T. reinhardti*, *T. rubiginosus*, *T. taroba*, *T. trefauti*, *T. triguttatus*, *T. variegatus*, *T. vermiculatus*, and *T. zonatus*). Distinguished from *T. mboycy* by pectoral-fin length (7.7-9.1 *vs.* 9.9-13.8 mm SL). Distinguished from *T. naipi* by number of odontodes of interopercular patch (20-32 *vs.* 12-15). Distinguished from *Trichomycterus* sp. n. D by posterior fontanel extended from the supraoccipital to the frontals (*vs.* posterior cranial fontanel restricted to supraoccipital), origin of dorsal fin at vertical through between tip of pelvic fins and anterior insertion of anal fin (*vs.* at vertical through the last third of pelvic fins), maxillary barbel not surpassing the posterior tip of interopercular patch of odontodes (*vs.* maxillary barbel surpassing posterior margin of interopercular patch of odontodes, usually, reaching or surpassing pectoral fin insertion), number of odontodes of opercular patch (13-17 *vs.* 8-11). Additionally, *Trichomycterus* sp. n. C distinguished from remaining species from laguna dos Patos system by origin of dorsal fin at vertical through between tip of pelvic fins and anterior insertion of anal fin (*vs.* at vertical through the last third of pelvic fins in *Trichomycterus* sp. n. A and *Trichomycterus* sp. n. B); number of teeth (20-23) in ceratobranchial 5 (*vs.* 36-39 in *Trichomycterus* sp. A and 12-13 in *Trichomycterus* sp. B); number of teeth (23-25) in pharyngobranchial 4 (*vs.* 35-40 in *Trichomycterus* sp. n. A and 18-20 in *Trichomycterus* sp. n. B); color patter of dorsum and flank of body dark brown mottled over a light yellow background and may form two longitudinal stripes (midlateral and ventrolateral) with notched borders (*vs.* flank and dorsum with irregular rounded black spots in *Trichomycterus* sp. n. A and *T. tropeiro*, flank with irregular dark blotches progressively joined dorsally, progressively larger and joined dorsally and forming extended black pigmented regions with light yellow gaps *Trichomycterus* sp. n. B). *Trichomycterus* sp. n. C is further distinguishable from *Trichomycterus* sp. n. B by insertion of first dorsal-fin pterygiophore anterior to neural spine of 20th to 22th vertebrae (*vs*. anterior to neural spine of 17th to 18th vertebrae). *Trichomycterus* sp. n. C is further distinguishable from *T. tropeiro* by the presence of pelvic

girdle and pelvic fins (*vs*. absence); and absence of pores i1 and i3 of infraorbital sensory canal (*vs.* presence).

Description. Morphometric data for holotype and paratypes given in Table 3. Body elongate, trunk roughly cylindrical and gradually compressed towards caudal fin. Dorsal profile of trunk convex in first half length, and then straight to insertion of dorsal fin. Ventral profile of trunk straight to slightly convex. Dorsal and ventral profile of caudal peduncle straight.

Head depressed, trapezoidal in dorsal view, wider posteriorly. Dorsal profile straight and ventral profile straight to slightly convex. Snout rounded in dorsal view. Eyes readily visible, elliptical anteroposteriorly and dorsally oriented; orbital rim not free, eyes covered with skin thin and transparent. Each eye located over posterior termination of shallow and small longitudinal crest beginning in posterior nostril making eyes visible in lateral view. Nostrils with same size, smaller than diameter of eye. Anterior nostril surrounded by fleshy flap of integument, posterolaterally continuous with nasal barbel. Posterior nostril surrounded anterolaterally by thin flap of integument. Gill openings not constricted, united with isthmus anteriorly forming a free fold. Mouth subterminal, its corners posteriorly oriented. Lower lip with conspicuous fleshy lobes along lateral limits and internal to origin of rictal barbels. Lips with small papillae, largest on inner surface of upper lip.

Barbels with large bases and tapering gradually toward to tip. Tip of nasal barbel usually reaching between pores i11 and po1, at most the half length between them. Origin of nasal barbels on posterolateral portion of integument flap around anterior nostril. Maxillary barbel usually extending between anterior tip of interopercular patch of odontodes and its posterior tip. Rictal barbel slightly shorter than maxillary barbel.

Pectoral fin with distal margin rounded, I+5* rays (one specimen with I+6) (n = 77), the first ray short, not prolonged as filament. Dorsal fin with distal margin rounded, semicircular when fin expanded, one to three unsegmented rays (n = 9), I-II+6-7 rays (n = 77), usually II+7*, origin at vertical through between tip of pelvic fins and anterior insertion of anal fin, usually in the papillae urogenital. Anal fin slightly smaller than dorsal fin, with distal margin rounded, one to three unsegmented rays (n = 9), II+4-5-6* rays (n = 77), usually II+5, origin at vertical through between anterior insertion of dorsal fin and the

half of its length. Pelvic fin with distal margin rounded reaching, at most the anterior margin of the urogenital papilla, I+4* rays (one specimen with I+3) (n = 77). Inner margin of pelvic fins very close near their base. Urogenital papilla nearer tip of pelvic fins than origin of anal fin. Pelvic girdle with two basipterygium united medially by cartilage with two bifid processes elongate (external process and internal process) and medial process short (in two of eight specimens medial process united to internal process). Pelvic splint thin with comma-shaped, parallel to first pelvic ray.

Caudal fin with distal margin rounded to straight with dorsal and ventral edges rounded, procurrent caudal-fin rays 15-19 dorsally (n = 9) and 11-15 ventrally (n = 9), I+5+5-6+I-II principal rays (n = 77), usually I+5+6+I*, branched rays splitting up to thrice. Lower caudal plate with parhypural and hypurals 1 and 2 co-ossified and fused to compound caudal centrum (Fig. 20). Upper caudal plate with hypurals 3, 4, 5 fused; and uroneural. Vertebrae 38-40 (n = 9), ribs 12-15 (n = 9), first rib straight and thickest, last rib rudimentary. Dorsal-fin pterygiophores 7-8 (n = 9), first one inserting anterior to neural spine of 20th to 22th vertebrae. Anal-fin pterygiophores 5-6 (n = 9), first one inserting anterior to hemal spine of 22th to 24th vertebrae.

Mesethmoid with anterior margin slightly concave, cornuas short and thick, width of their bases similar to their length (Fig. 21). Anterior cranial fontanel restricted to small and rounded opening situated between frontals and epiphyseal bar. Posterior cranial fontanel long and narrow extending from posterior portion of frontals to supraoccipital. Epiphyseal bar longer than wide. Antorbital short and anteriorly expanded. Tendon-bone supraorbital elongate, anteriorly expanded, approximately three times larger than antorbital. Anterior portion of sphenotic anterolaterally directed in dorsal view. Sphenotic, prootic, and pterosphenotic entirely fused to each other. Vomer arrow-shaped, with long posterior process extending to parasphenoid. Parasphenoid with long and pointed process extending to basioccipital. Anterior portion of Weberian complex fused to basioccipital. Weberian capsule with lateral opening smaller than lateral profile of capsule.

Premaxilla rectangular with 74-76 curved, flat vertically to slightly conical, and blunt teeth (n = 3), variable in size, distributed with some irregularities in up to three rows. Maxilla large, boomerang-shaped, shorter than premaxilla. Lower jaw with 79-91 curved, flat vertically, and blunt teeth (n =3), variable in size, few teeth at base of coranoid process to

three discernible rows near dentary symphysis (Fig. 22). Autopalatine with anterior and mesial margin straight, distal margin straight to slightly concave, and small posterior process extending slightly over metapterygoid.

Metapterygoid large and laminar connecting with quadrate through cartilage.

Hyomandibula well-developed. Preopercle long and narrow, in contact with ventral margins of both quadrate and hyomandibula. Opercular patch of odontodes rounded with 13-17 conical odontodes (n = 9). Interopercular patch of odontodes elongate with 20-32 conical odontodes (n = 9), more concentrated in posterior portion. Odontodes of both opercular and interopercular patches gradually curving medially and increasing in size towards posterior portion.

Hyoid arch with triangle-shaped ventral hypohyal (Fig. 23). Anterior ceratohyal elongate widening at tips, posterior ceratohyal short and triangle-shaped, cartilage between bones with length and wide approximately equal. Nine branchiostegal rays (eight in one side of one specimen) (n = 9), five in ceratohyal anterior, one in ceratohyal posterior and three in cartilage between these bones. Last four branchiostegal rays wider than anterior ones. Dorsal hypohyal and interhyal absent. Urohyal with expanded anterior head, two elongate processes with wide bases, decreasing distally and bearing rounded tips; and laminar, elongate and narrow posterior process (Fig. 24).

Basibranchial 1 absent. Basibranchials 2 and 3 connected to each other with approximately equal lengths and cartilage at their tips (Fig. 25). Ossified portion of basibranchial 2 distinctly wider than basibranchial 3. Basibranchial 4 completely cartilaginous with hexagon-shaped. Hypobranchial 1 with similar size to basibranchial 2, however narrower, with cartilage in their tips. Hypobranchials 2 and 3 with reduced portion ossified located lateroanteriorly, slightly more elongate in hypobranchial 3; and large area of cartilage, slightly larger in hypobranchial 3. Hypobranchial 4 absent. Five elongate and narrow ceratobranchials with cartilage in their tips. Posterior margin of ceratobranchials 2 and 3 with concavity at its posterior margin, larger in ceratobranchial 3. Ceratobranchial 5 expanded posteromedially with 20-23 conical, elongate and pointed teeth located dorsally, arranged in 3 rows (n = 2). Five epibranchials, first three elongate and narrow with cartilage in their tips. Epibranchials 1 and 2 with triangle-shaped process at its anterior margin, larger in epibranchials 1. Epibranchial 3 with robust uncinate process at its posterior

margin. Epibranchial 4 with rectangular aspect. Epibranchial 5 small, narrow, and curved, completely cartilaginous. Pharyngobranchials 1 and 2 absent. Pharyngobranchial 3 similar to hypobranchial 1, however shorter, with cartilage in their tips. Pharyngobranchial 4 curved and well ossified connected to a plate with 23-25 conical, elongate and pointed teeth (n = 2), arranged in up to three rows, growing in length anteroposteriorly.
Head sensory canals with simple (non-dendritic) tubes ending in single pores. Supraorbital sensory canal complete with pores paired s1, s3 and s6 (Fig. 21). Pores s1 located between anterior nostrils, pores s3 located in same longitudinal row of pores s1 after posterior nostrils and pores s6 in interorbital space. Infraorbital sensory canal incomplete; pores i1 and i3 absent; pores i10, located behind the eye; and pores i11, located laterally to posterior margin of eye. Pos-otic pores po1, located laterally to anterior margin of opercular patch of odontodes, and po2, located laterally to middle length of opercular patch of odontodes. Lateral-canal very short with 2 pores, located above insertion of pectoral fins and just after gill openings.

Coloration in alcohol. *Trichomycterus* sp. n. C presents variable color pattern. Most of types present the dorsum and flank of body dark brown mottled over a light yellow background (Fig. 19). Some specimens may present two stripes (midlateral and ventrolateral) with notched borders on flank of body, more evident in smallest specimens and distinguishable only on trunk in largest specimens; ventrolateral stripe interrupted at some points forming irregular blotches (Fig. 26). Ventral surface of body light yellow with diffuse and small black spots between pectoral fins insertion and near to pelvic fins insertion, area between pelvic and anal fins and caudal peduncle dark brown mottled over a light yellow background. Head dark brown mottled over a light yellow background dorsally and yellow ventrally. Pectoral, dorsal, anal, and caudal fins spotted on basal portion, becoming inconspicuous toward to tips, and edges lighter. Pelvic fin unpigmented. Barbels with dark pigmentation dorsally and lighter ventrally. Some larger specimens with small spots on outer skin layer of caudal peduncle and dorsum.

Distribution and ecological notes. *Trichomycterus* sp. n. C is distributed in basins of rio Jacuí, rio Pardo, and rio Taquari-Antas basins, laguna dos Patos system (Fig. 8). The

species is widely distributed in the upper portion of rio Jacuí basin, occurring between altitudes of 700 and 124 m. One lot is from the headwaters of rio Pardo basin, at altitude of 625 m. In the Taquari-Antas basin the species occurs in upper portion of the Carreiro, Guaporé, and Forqueta rivers, between altitudes of 417 and 688 m. The type locality is a rapid flow watercourse with clear water, rocky bottom and submersed vegetation (Fig. 27), located at an altitude of approximately 405 m. In this site the specimens were associated with submerged vegetation and collected with *Ancistrus brevipinnis* (Regan, 1904); *Eurycheilichthys limulus* Reis & Schaefer, 1998; and *Rineloricaria cadeae* (Hensel, 1868). The stomach of six c&s specimens contained aquatic larvae of Lepidoptera and Simuliidae (Diptera) and nymphs of Ephemeroptera and Plecoptera.

Remarks. *Trichomycterus* sp. n. C presents intraspecific variation in color pattern related to ontogenetic variation. Although Bockmann & Sazima (2004) considered the body pigmentation pattern highly conserved in known species of *Trichomycterus*, a intraspecific variation in coloration is present in *T. caipora* (Lima *et al.*, 2008), *T. iheringi* associated to body size and microhabitat preference (Silva *et al.*, 2010), and *T. santanderensis* Castellanos-Morales, 2007 between young and adults (Castellanos-Morales, 2007). The ontogenetic variation in *Trichomycterus* sp. n. C is clear on lot UFRGS 14992 (six specimens with 40.5-92.5 mm SL), in which the smallest specimens present one evident stripe on flank of body that gradually become indistinguishable till the largest specimens (Fig. 26). However this ontogenetic variation is not observed in all samples. In other lots all specimens present the mottled pattern (UFRGS 14500, 11 specimens with 32.0-74.5 mm SL), regardless the body size. Besides the coloration, however, no additional differences were found between these populations that allow us to separate them and ontogenetic variation in the color pattern seems to appear only in some populations of the species. Seven specimens from rio do Sinos basin are poorly preserved and were not measured or counted (MCP 26148), however the color pattern mottled over a light yellow background is present in all specimens, and one c&s of them possess the lower jaw with blunt teeth which leads us to believe to be *Trichomycterus* sp. n. C.

Eight specimens; seven from rio Taquari-Antas basin (MCP 35059, UFRGS 9185, UFRGS 13951, UFRGS 14228, UFRGS uncat., and UFRGS uncat.), and one from rio do Sinos

basin (MCN 16301); present the counts and morphometric similar to *Trichomycterus* sp. n. C, except in number of pectoral-fin rays (I+6 *vs.* I+5 in 76 of 77 specimens of *Trichomycterus* sp. n. C). The color pattern of body of these non-types is completely dark brow while *Trichomycterus* sp. n. C possess color pattern mottled over a light yellow background and may present two stripes (midlateral and ventrolateral) with notched borders on flank of body. In addition to these morphological differences, the specimens from Taquari-Antas basin are distributed in the lower stretches (altitude between 88 and 330 m) compared to the region of occurrence of *Trichomycterus* sp. n. C and we opted do not include these eight specimens in the type series.

***Trichomycterus* sp. n. D, new species**
Figs. 28-34 Table 4

Holotype. MCN uncat., 61.1 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Caraá, rio do Sinos, 29º45'44"S 50º19'39"W, 30 Jun 2006, B. B. Calegari, M. A. Azevedo & R. Hirano.

Paratypes. All from Brazil, State of Rio Grande do Sul, rio do Sinos basin. MCN uncat., 3, 26.3-70.9 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Caraá, rio do Sinos, 29º44'58"S 50º16'59"W, 30 Jun 2006, B. B. Calegari, M. A. Azevedo & R. Hirano. All the following lots from Brazil, State of Rio Grande do Sul, Municipality of Caraá, rio do Sinos, 29º43'32"S 50º16'56"W. MCN uncat., 1 (c&s). 51.6 mm SL, 30 Jul 2007, M. A. Azevedo, T. Aguzzoli & M. Pairet. MCN uncat., 1, 51.6 mm SL, 14 Mar 2007, F. Becker, M. A. Azevedo & T. Aguzzoli. MCN uncat., 2, 36.3-53.7 mm SL, 28 Nov 2007, M. A. Azevedo & T. Aguzzoli. MCN uncat., 5 (1 c&s), 35.0-61.9 mm SL, 02 Feb 2007, M. A. Azevedo & T. Aguzzoli. MCN uncat., 2, 39.4-47.9 mm SL, 26 Jun 2007, M. A. Azevedo, T. Aguzzoli & M. Pairet.

Diagnosis. *Trichomycterus* sp. n. D is distinguishable from all congeners by the elongate posterior cranial fontanel restricted to supraoccipital (*vs.* posterior fontanel extended from the supraoccipital to the frontals). *Trichomycterus* sp. n. D is further distinguishable from

its congeners from southeast and southern of Brazil (except *T. mboycy, T. naipi,* and *Trichomycterus* sp. n. C) by the number of pectoral-fin rays (I+5, one of 15 specimens with I+6, *vs.* I+6 or more pectoral-fin rays in *T. castroi, T. davisi, T. diabolus, T. guaraquessaba, T. igobi, T. iheringi, T. papilliferus, T. plumbeus, T. santaeritae, T. stawiarski, T. tropeiro, T. tupinamba, Trichomycterus* sp. n. A, and *Trichomycterus* sp. n. B) and by the first ray of pectoral fin not prolonged as filament (*vs.* first ray of pectoral fin prolonged as filament in *T. albinotatus, T. alternatus , T. auroguttatus, T. brasiliensis, T. brunoi, T. caipora, T. candidus, T. caudofasciatus, T. claudiae, T. concolor, T. crassicaudatus, T. fuliginosus, T. giganteus, T. goeldii, T. immaculatus, T. itacambirussu, T. itacambariensis, T. itatiayae, T. jacupiranga, T. jequitinhonhae, T. landinga, T. longibarbatus, T. maculosus, T. macrotrichopterus, T. maracaya, T. mariamole, T. mimonha, T. mirissumba, T. nigricans, T. nigroauratus, T. novalimensis, T. pantherinus, T. paolence, T. paquequerense, T. pauciradiatus, T. potschi, T. reinhardti, T. rubiginosus, T. taroba, T. trefauti, T. triguttatus, T. variegatus, T. vermiculatus,* and *T. zonatus*). *Trichomycterus* sp. n. D is further distinguishable from *T. mboycy* and *T. naipi* by color pattern of flank and dorsum of body dark brown mottled over a light yellow background (*vs.* flank of body with small spots in *T. mboycy*; flank of body with three dark longitudinal stripes in *T. naipi*); barbel maxillary length (68.2-87.7 *vs.* 50.3-63 mm HL in *T. mboycy*; 34.1-68.2 mm HL in *T. naipi*). Additionally, *Trichomycterus* sp. n. D distinguished from remaining species from laguna dos Patos system by number of odontodes of opercular patch (8-11 *vs.* 13 or more in *Trichomycterus* sp. n. A, *Trichomycterus* sp. n. B, *Trichomycterus* sp. n. C, and *T. tropeiro*); maxillary barbel always surpassing posterior margin of interopercular patch of odontodes, usually, reaching or surpassing pectoral fin insertion (*vs.* maxillary barbel usually extending between anterior tip of interopercular patch of odontodes and its posterior tip, at most slightly surpassing the posterior tip, never reaching the pectoral-fin insertion in *Trichomycterus* sp. n. A and *T. tropeiro*; maxillary barbel not surpassing the posterior tip of interopercular patch of odontodes in *Trichomycterus* sp. n. B and *Trichomycterus* sp. n. C).

Description. Morphometric data for holotype and paratypes given in Table 4. Body elongate, trunk roughly cylindrical and gradually compressed caudally. Dorsal profile of

trunk convex in first half length, and then straight to insertion of dorsal fin. Ventral profile of trunk straight. Dorsal and ventral profiles of caudal peduncle slightly concave to straight. Head depressed, trapezoidal to square in larger specimens in dorsal view, wider posteriorly. Dorsal profile straight and ventral profile straight to slightly convex. Snout rounded in dorsal view. Eyes readily visible, rounded and dorsally oriented, orbital rim not free, eyes covered with skin thin and transparent. Each eye located over posterior termination of shallow and small longitudinal crest beginning in posterior nostril making eyes visible in lateral view.

Nostrils with same size, smaller than diameter of eye. Anterior nostril surrounded by fleshy flap of integument, posterolaterally continuous with nasal barbel. Posterior nostril surrounded anterolaterally by thin flap of integument. Gill opening not constricted, united with isthmus anteriorly forming a free fold. Mouth subterminal, its corners posteriorly oriented. Lower lip with conspicuous fleshy lobes along lateral limits and internal to origin of rictal barbels. Lips with small papillae, largest on inner surface of upper lip.

Barbels with larger bases and tapering gradually toward to tip. Tip of nasal barbel usually reaching the opercular patch of odontodes, always surpassing half length between pores i11 and po1. Origin of nasal barbels on posterolateral portion of integument flap around anterior nostril. Maxillary barbel usually reaching or surpassing pectoral-fin insertion, always surpassing posterior margin of interopercular patch of odontodes. Rictal barbel slightly shorter than maxillary barbel.

Pectoral fin with distal margin rounded to truncate, I+5* (one specimen with I+6) (n = 15), the first ray short, not prolonged as filament. Dorsal fin with distal margin rounded, semicircular when fin expanded, two unsegmented rays (n = 2), II-III+6-8 rays (n = 15), usually II+7* (n = 15), origin at vertical through the last third of pelvic fins. Anal fin slightly smaller than dorsal fin, with distal margin rounded, two unsegmented rays (n = 2), II+4*-5 rays (n = 15), usually II+5, origin at vertical through the middle length of dorsal-fin base. Pelvic fin with distal margin rounded reaching, at most anterior margin of urogenital papillae, I+4* (one specimen with I+3) (n = 15). Inner margin of pelvic fins very close near their bases. Urogenital papillae nearer tip of pelvic fins than origin of anal fin.

Pelvic girdle with two basipterygium united medially by cartilage with two bifid processes elongate (external process and internal process) and medial process short. Pelvic splint thin with comma-shaped, parallel to first pelvic ray.
Caudal fin with distal margin rounded, procurrent caudal-fin rays 15-16 (n = 2) and 10-13 ventrally (n = 2), I+5+6+I principal rays (n = 15), branched rays splitting twice. Lower caudal plate with parhypural and hypurals 1 and 2 co-ossified and fused to compound caudal centrum (Fig. 29). Upper caudal plate with hypurals 3, 4, 5 fused; and uroneural. Vertebrae 37-38 (n = 2); ribs 12 (n = 2), first rib straight and thickest, last rib rudimentary. Dorsal-fin pterygiophores 7-8 (n = 2), first one inserting anterior to neural spine of 19th vertebrae. Anal-fin pterygiophores 6 (n = 2), first one inserting to hemal spine of 21th or 22th vertebrae.
Mesethmoid with anterior margin slightly concave to straight, cornuas short and thick, width of their bases similar to their length. Anterior cranial fontanel absent or restricted to very small opening situated between frontals (Fig. 30), epiphyseal bar absent. Posterior cranial fontanel elongate and restricted to supraoccipital. Antorbital short and anteriorly expanded. Tendon-bone supraorbital elongate, with rod-like shaped. Anterior portion of sphenotic directed anteriorly in dorsal view. Sphenotic, prootic, and pterosphenotic entirely fused to each other. Vomer arrow-shaped, with long posterior process extending to parasphenoid. Parasphenoid with long and pointed process extending to basioccipital. Anterior portion of Weberian complex fused to basioccipital. Weberian capsule with lateral opening smaller than lateral profile of capsule.
Premaxilla rectangular with 78 teeth conical, curved, and pointed (n = 1), variable in size, distributed with some irregularities in up to three rows. Maxilla large, boomerang-shaped, shorter than premaxilla. Lower jaw with 75 teeth conical, curved, and pointed (n = 1), variable in size, few teeth at base of coranoid process to three discernible rows near dentary symphysis. Autopalatine with anterior margin straight, mesial and distal margins concaves and small posterior process (Fig. 31) extending slightly over the quadrate. Metapterygoid large and laminar connecting with quadrate through cartilage. Hyomandibula well-developed. Preopercle long and narrow, in contact with ventral margins of both quadrate and hyomandibula. Opercular patch of odontodes rounded with 8-11 conical odontodes (n = 2). Interopercular patch of odontodes elongate with 22-30

conical odontodes (n = 2), more concentrated in posterior portion. Odontodes of both opercular and interopercular patches gradually curved medially and increasing in size towards posterior portion.

Hyoid arch with triangle-shaped ventral hypohyal (Fig. 32). Anterior ceratohyal elongate widening at tips, posterior ceratohyal short and triangle-shaped, cartilage between bones approximately equal in width and length. Eight branchiostegal rays (n = 2), five in ceratohyal anterior, one in ceratohyal posterior and two in cartilage between these bones. Last three branchiostegal rays wider than anterior ones. Dorsal hypohyal and interhyal absent. Urohyal with expanded anterior head, two elongate processes with wide bases, decreasing distally and bearing pointed tips; and laminar, elongate and narrow posterior process (Fig. 33).

Basibranchial 1 absent. Basibranchials 2 and 3 connected to each other with approximately equal lengths and cartilage at their tips (Fig. 34). Ossified portion of basibranchial 2 distinctly wider than basibranchial 3. Basibranchial 4 completely cartilaginous. Hypobranchial 1 with similar size to basibranchial 2, however narrower, with cartilage in their tips. Hypobranchials 2 and 3 with reduced portion ossified located lateroanteriorly, larger in hypobranchial 2; and large area of cartilage, larger in hypobranchial 3. Hypobranchial 4 absent. Five elongate and narrow ceratobranchials with cartilage in their tips. Posterior margin of ceratobranchials 2 and 3 with concavity at its posterior margin, larger in ceratobranchial 3. Ceratobranchial 5 expanded posteromedially with 21-22 conical, elongate and pointed teeth located dorsally, arranged in up to 3 rows (n = 1). Five epibranchials, first three elongate and narrow with cartilage in their tips. Anterior margin of epibranchials 1 and 2 with triangle-shaped process, slightly larger in epibranchials 1. Epibranchial 3 with robust uncinate process at its posterior margin. Epibranchial 4 with rectangular aspect. Epibranchial 5 small, completely cartilaginous. Pharyngobranchials 1 and 2 absent. Pharyngobranchial 3 similar to hypobranchial 1, however shorter, with cartilage in their tips. Pharyngobranchial 4 curved and well ossified connected to a plate with 22-25 conical, elongate and pointed teeth, arranged in up to three rows, growing in length anteroposteriorly (n = 1).

Head sensory canals with simple (non-dendritic) tubes ending in single pores. Supraorbital sensory canal complete with pores paired s1, s3 and s6. Pores s1 located between anterior

nostrils, pores s3 located in same longitudinal row of pores s1 after posterior nostrils and pores s6 in interorbital space. Infraorbital sensory canal incomplete; pores i1 and i3 absent; pores i10, located behind the eye; and pores i11, located laterally to posterior margin of eye. Pos-otic pores po1, located laterally to anterior margin of opercular patch of odontodes, and po2, located laterally to middle length of opercular patch of odontodes. Lateral-canal very short with 2 pores, located above insertion of pectoral fins and just after gill openings.

Coloration in alcohol. Dorsum and flank of body and head dark brown mottled over a light yellow background, progressively lighter ventrally (Fig. 28). Ventral surface of head and trunk yellow; area between pelvic and anal fins and ventral surface of caudal peduncle light brown. Pectoral, dorsal, anal, and caudal fins weakly pigmented with small light brown spots and lighter on edges. Pelvic fin unpigmented. Barbels with dark pigmentation dorsally and lighter ventrally.

Distribution and ecological notes. *Trichomycterus* sp. n. D is apparently endemic to the rio do Sinos, laguna dos Patos system (Fig. 8). The rio do Sinos at the locality where most types (11 specimens) were collected is narrow (ranging from 5 to 9 m asl.) and shallow (depth less to 1 m), with fast current and rapids, large slope, clear waters , substrate consists mainly of large rocks, and preserved riparian vegetation (Dala-Corte & Azevedo, in prep.) (Fig. 35). The type locality is located at an altitude of approximately 109 m and the two other lots of types from 169 m and 266 m asl. The stomach contents of one specimen c&s contained larvae of Chironomidae (Diptera) and pupa of Diptera.

Remarks. The cranial fontanel presents several modifications in Trichomycteridae. The basal subfamilies Copionodontinae and Trichogeninae possess an anterior cranial fontanel completely open and extended as a long slit from mesethmoid to the epiphyseal bar (de Pinna, 1992a). The genus *Ituglanis* present only the posterior cranial fontanel, which is reduced to a small round orifice restricted to the supraoccipital (Costa & Bockmann, 1993) or even absent in *I. macunaima* (Datovo & Landim, 2005). The cranial fontanels completely closure also occurs in the subfamilies Glanapteryginae, Stegophilinae, and

Vandelliinae (Baskin, 1973). Bockmann *et al.*, (2004) identified the anterior cranial fontanel partially or completely closed as a derived feature that corroborate the monophyly of clade 2 (*sensu* de Pinna 1992a, 1998). The anterior cranial fontanel is absent or restricted to very small opening in *Trichomycterus* sp. n. D. However, *Trichomycterus* sp. n. D possess the posterior cranial fontanel elongate and restricted to supraoccipital (Fig. 30) distinct of most Trichomycteridae, that present the posterior fontanel large and elongate is present in always expanded to the frontals (Wosiacki, 2002, pers. obs.).

Trichomycterus sp. n. D present the tips of the lateral processes of urohyal thin and elongate (Fig. 33), a synapomorphy of the clade forming for *Scleronema*, *Ituglanis*, Vandelliinae, Stegophilinae, Tridentinae, Glanapteryginae, and Sarcoglanidinae (Costa & Bockmann, 1993); and the anterior portion of sphenotic directed anteriorly (Fig. 30), which is one of three synapomorphies for the genus *Ituglanis* proposed by Costa & Bockmann (1993). However, Wosiacki (2002) related that this synapomorphy is not unique to *Ituglanis*, present even basal subfamilies of Trichomycteridae (Copionodontinae and Trichogeninae). The other two synapomorphies for the genus *Ituglanis* proposed by Costa & Bockmann (1993): autopalatine with a deep concavity on medial margin and the supraoccipital fontanel (= posterior cranial fontanel) reduced to a small round orifice are not present in *Trichomycterus* sp. n. D (see Figs. 31 and 30, respectively).

The new species is herein tentatively included in the genus *Trichomycterus*. The presence of the posterior cranial fontanel reduced and the tips of the lateral processes of urohyal thin and elongate, both not related from other species of genus, may be indicative of possible relationships to *Ituglanis*, but we prefer to keep the species in *Trichomycterus* until an analysis with additional characters is made.

Other two lots (MCP 26148 and MCN 16301) from tributaries north of rio do Sinos basin were analyzed and definitely are not *Trichomycterus* sp. n. D (see remarks of *Trichomycterus* sp. n. C).

Key to the species of *Trichomycterus* from laguna dos Patos system

1. Absence of pelvic fins, I+6 pectoral fin rays, presence of pores i1 and i3 of the infraorbital sensory canal ……. *T. tropeiro*

1'. Presence of pelvic fins……..……2

2. Flank of body with spots well defined, I+6 pectoral-fin rays……*Trichomycterus* sp. n. A

2'. Flank of body mottled, with blotches or stripes, never with spots well defined……..…….…….3

3. Maxillary barbel surpassing the posterior margin of interopercular patch of odontodes, usually reaching or surpassing the pectoral-fin insertion……..… *Trichomycterus* sp. n. D

3'. Maxillary barbel not surpassing the posterior margin of interopercular patch of odontodes……..…4

4. Flank of body with blotches, I+6 pectoral-fin rays……*Trichomycterus* sp. n. B

4'. Flank of body mottled or with stripes, I+5 pectoral-fin rays……...….. *Trichomycterus* sp. n. C

Discussion

Based on current knowledge of the interrelationships in the family Trichomycteridae (summarized in de Pinna, 1998) the four new species herein described are assigned to the subfamily Trichomycterinae, a non-monophyletic group included in his clade 2 (composed of all trichomycterids except Copionodontinae and Trichogeninae). The clade 2 (*sensu* de Pinna, 1998) includes, besides the Trichomycterinae, the subfamilies Tridentinae, Stegophilinae, Vandelliinae, Sarcoglanidinae, and Glanapteryginae, recognized by Costa & Bockmann (1993) and called clade TSVSG. Costa & Bockmann (1993) also proposed the new genus *Ituglanis* (to include a monophyletic group of species first recognized as *Trichomycterus*) and that the genus *Scleronema* does not belong to the subfamily Trichomycterinae, being both closely related to the clade TSVSG.

The four new species present the 11 synapomorphies that support the clade 2 (Bockmann *et al*., 2004; de Pinna, 1998): sphenotic, prootic, and pterosphenoid fused; incomplete

infraorbital branch of latero-sensory canal system; Weberian capsule with a small lateral opening, much smaller than its lateral profile; interhyal absent, five or fewer pelvic-fin rays; presence of *protactor operculi* muscle; anterior cranial fontanel partially or completely closed; dorsal caudal-fin plate with six or fewer rays; ventral caudal-fin plate with eight or fewer rays; dorsal caudal-fin lobe with five or fewer branched rays; and ventral caudal-fin lobe with six or fewer branched rays. The four new species do not share the synapomorphies of the subfamilies Tridentinae, Stegophilinae, Vandelliinae, Sarcoglanidinae, and Glanapteryginae included in clade TSVSG and neither those of the genera *Ituglanis* and *Scleronema*, being included in Trichomycterinae. The new species also lack the synapomorphies of the trichomycterine genera *Bullockia*, *Eremophilus*, *Hatcheria*, *Rhizosomichthys*, and *Silvinichthys* (*cf.* Eigenmann, 1918 and Arratia, 1998), being included in the paraphyletic genus *Trichomycterus*.

The new species are clearly distinguishable from *Trichomycterus tropeiro*, the single species of genus described from thelaguna dos Patos system (Ferrer & Malabarba, 2011) by the presence of pelvic girdle and pelvic fins, that are absent in the last species.

In the few studies that attempted to elucidate the relationships among species of *Trichomycterus* of south and southern of Brazil, Wosiacki & de Pinna (2008a) recognized a monophyletic group formed by the species endemic from the rio Iguaçu basin (*T. crassicaudatus*, *T. igobi*, and *T. stawiarski*) based in three putative synapomorphies: the procurrent caudal-fin rays thickly ossified and rigid, an extending area of dorsal procurrent caudal-fin rays, and 10-11 branchiostegal rays; none are present in the species described herein from the laguna dos Patos system.

Costa (1992) proposed the *T. brasiliensis* species-complex, redefined by Barbosa & Costa (2003), and posteriorly by Bockmann & Sazima (2004) based on the presence of four putatively derived traits: (1) large, horizontally-elongate, and well-defined blotches in four longitudinal rows of deeper-lying pigmentation on trunk; (2) pectoral fin with I+5-6 rays; (3) separation between the anterior and posterior cranial fontanels by the primordial epiphyseal cartilaginous bar being present only larger specimens; (4) and pelvic-fin bases very close to each other, sometimes in contact.

Trichomycterus sp. n. A and *T. tropeiro* possess rounded spots on trunk, however rarely horizontally-elongate and forming four longitudinal rows as described for the *T.*

brasiliensis species-complex (character 1). *Trichomycterus* sp. n. B possess dark blotches on trunk, however irregular in shape and always joined dorsally not forming four longitudinal rows. *Trichomycterus* sp. n. C and *Trichomycterus* sp. n. D clearly do not present the color pattern with well-defined blotches. The separation between the anterior and posterior cranial fontanels by the primordial epiphyseal cartilaginous bar (character 3) was also found absent in all species from the laguna dos Patos system.

The four species herein described share the characters 2 and 4, and this may indicate possibly relationships of the new species with the *T. brasiliensis* species-complex. The species of *Trichomycterus* from laguna dos Patos system present I+5-6 pectoral-fin rays (modally I+5 in *Trichomycterus* sp. n. C and *Trichomycterus* sp. n. D; I+6 in *T. tropeiro*, *Trichomycterus* sp. n. A, and *Trichomycterus* sp. n. B). The lower number of pectoral-fin rays (I+5-6) is considered a derived state in *T. brasiliensis* species-complex, but also occurs in species apparently not closely related to them (Bockmann & Sazima, 2004), making a hypothesis of relationships based in this character tentative, but not conclusive.

The pelvic-fin bases very close to each other, sometimes in contact was considered as derived in *T. brasiliensis* species-complex (Bockmann & Sazima, 2004) and is also present in all *Trichomycterus* from laguna dos Patos system (except *T. tropeiro* which not possess pelvic fins), suggesting again a possible relationship of the species described herein with *T. brasiliensis* species-complex.

The new species do not possess autapomorphic characters, except *Trichomycterus* sp. n. D that possess the posterior cranial fontanel elongate and restricted to the supraoccipital, but are clearly distinguishable from most congeners of south and southern of Brazil by lower number of pectoral-fin rays (I+5-6) rays and by the first pectoral-fin ray not prolonged as filament.

The combination of these two characters is uncommon in valid species of *Trichomycterus* from south and southern of Brazil, present only in *T. davisi*, *T. mboycy*, *T. naipi*, *T. papilliferus*, *T. plumbeus*, and *T. tropeiro*. All these species occurs in the rio Iguaçu drainage, except *T. davisi* (that besides the rio Iguaçu basin occurs also in drainages of upper rio Paraná and rio Ribeira do Iguape) and *T. tropeiro*, that is restrict from laguna dos Patos system.

Nevertheless, the new species from laguna dos Patos system described herein, two undescribed species (in prep. and cited in comparative material as *Trichomycterus* sp. n. 1 and *Trichomycterus* sp. n. 2) from rio Uruguay, and other undescribed species of *Trichomycterus* from rio Uruguay basin (pers. obs.) also possess this combination of characters.

Trichomycterus tropeiro, *Trichomycterus* sp. n. A, and *Trichomycterus* sp. n. B share I+6 pectoral-fin rays, the distribution in the upper courses from rio da Antas basin and present similar color pattern. Both *T. tropeiro* and *Trichomycterus* sp. n. A possess irregular black spots rounded on dorsum and flank on lighter background, while *Trichomycterus* sp. n. B possess dark blotches progressively larger and joined dorsally on a lighter background. These features and other morphological similarities lead us to believe that three species can be phylogenetically closely related.

Trichomycterus sp. n. C and *Trichomycterus* sp. n. D possess modally I+5 pectoral-fin rays and the color pattern mottled (may be variable in some specimens of *Trichomycterus* sp. n. C, see remarks). *Trichomycterus* sp. n. D is known only to upper course of rio dos Sinos, while *Trichomycterus* sp. n. C is distributed in upper courses of rio Jacuí, Pardo, Taquari-Antas with the tentative record of only seven specimens in the rio do Sinos basin (see remarks of *Trichomycterus* sp. n. C).

Trichomycterus sp. n. D, however, differs from *Trichomycterus* sp. n. C and all other species by the presence of the autapomorphic posterior cranial fontanel elongate and restricted to supraoccipital, instead of extending from the border with the frontals. It further differs in other morphological characters from *Trichomycterus* sp. n. C (*e. g.* branchiostegal rays, barbels length, number of odontodes of opercular patch).

Trichomycterus sp. n. C seem to be more related to undescribed species *Trichomycterus* sp. 1 from rio Uruguay and rio Parapanema (in prep.), that possess the color pattern on flank of body with three stripes and share others characters. However, these phylogenetic inferences are only tentative based in some morphological characters and in species with geographically close distributions. The high diversity of genus *Trichomycterus* in laguna dos Patos system seem to be also present in rio Uruguay basin and others smaller drainages of southern Brazil and only a phylogenetic analysis including all these species would allow a better supported hypothesis of relationships between these and other species of the genus.

Geographic distribution. The review of a large number of lots of Trichomycteridae collected in practically all extension of laguna dos Patos system revealed that genus *Trichomycterus* is restricted to the northern portion of that basin along the middle and upper stretches of the rio Jacuí itself and middle and upper stretches of its large tributaries, the rio do Sinos, rio Caí, rio Taquari-Antas, and rio Pardo basins (Fig. 8). The few lots of *Trichomycterus* listed in fish collections to the southern portion of the laguna dos Patos system are misidentified lots and, in fact, refer to *Ituglanis*, that has an external morphology very similar to *Trichomycterus*.

The analysis of comparative material from adjacent drainages to the north and northeast of laguna dos Patos system (rio Uruguay, rio Tramandaí, and rio Mampituba basins) allow us to suppose that the four new species are endemic to the laguna dos Patos system. However, their degree of endemism is variable. *Trichomycterus* sp. n. A is distributed in upper courses of rio das Antas and rio Caí basins; *Trichomycterus* sp. n. C is widely distributed in upper courses of rio Jacuí basin and tributaries of rio Taquari-Antas; *Trichomycterus* sp. B and *Trichomycterus* sp. n. D are known only from few localities in rio da Prata basin and rio dos Sinos, respectively. *T. tropeiro* is the unique species described from laguna dos Patos system and present a very restricted range, occurring only in headwaters of rio das Antas (Ferrer & Malabarba, 2011). The endemism and restricted ranges seem usual among species of *Trichomycterus*, since it is the dominant genus in the compilation of species with restricted-ranges listed in Nogueira *et al.* (2010), with 45 species.

The species of *Trichomycterus* from laguna dos Patos system usually are distributed in headwaters or upper courses and may present disjoint distributions in the same basin. *Trichomycterus tropeiro* is endemic to the headwaters of rio das Antas, occurring without sympatry with other species of the genus in localities above 1000 m asl (Ferrer & Malabarba, 2011). In the lower portions of rio das Antas basin (at altitudes of 681 to 941 m asl.) *T. tropeiro* is absent and *Trichomycterus* sp. n. A is found.

Other two species present a similar disjoint distributional pattern in the rio das Antas basin, *Astyanax brachypterygium* Bertaco & Malabarba, 2001 and *A. cremnobates* Bertaco & Malabarba, 2001 both restricted to higher altitudes but occurring above 1100 m asl and from 800 to 1000 m asl., respectively.

Trichomycterus sp. n. A appear to present the same restriction in rio Caí basin occurring only in its uppermost courses. Other species also are recognized as restricted to high altitudes in laguna dos Patos system (*e. g. Bryconamericus patriciae*; *Cnesterodon brevirostratus*; and *Jenynsia eirmostigma* Ghedotti & Weitzman, 1995).
It is difficult to delimit the distribution range of *Trichomycterus* sp. n. A. The species occurs in the rio da Prata basin and is not present in the other tributaries of the rio das Antas that are similar in configuration and size, like the rio Carreiro, rio Guaporé, and rio Forqueta. In the headwaters of these basins occurs only *Trichomycterus* sp. n. C, that is also unique in its range and widely distributed in the upper portion of rio Jacuí basin.
Trichomycterus sp. n. B is endemic to the rio da Prata basin and occurs sympatrically with *Hisonotus prata* and an undescribed species of *Eurycheilichthys*, known only to upper course of rio da Prata (Carvalho & Reis, 2010). Based on the coincidence in distribution of species *Hisonotus* and *Eurycheilichthys* from rio Taquari-Antas drainage and the mountain relief in which it flows, Carvalho & Reis (2010) claim that events which promoted their distribution and allopatric distribution are likely to be correlated.
In the rio do Sinos basin *Trichomycterus* sp. n. D is apparently endemic to the upper course, occurring along with seven specimens tentatively identified as *Trichomycterus* sp. n. C.
This study revealed an astonishing undescribed diversity of *Trichomycterus* with four undescribed species, along with one species just described in 2011. We expect that revision studies of other understudied basins in southern Brazil will reveal equally a number of new and undescribed taxa. The description of these is imperative to understand their diversity and relationships.

Comparative material. Nematogenyidae: *Nematogenys inermis*: MZUSP 107490, 4, 53.5-49.2 mm SL, Chile, Copequén, río Cachantún drainage. Trichomycteridae: Copionodontinae: *Copionodon pecten*: MZUSP 42461, holotype, 60.5 mm SL, Brazil, Bahia, rio Mucujê (rio Paraguaçu drainage); *Glaphyropoma rodriguesi*: MZUSP 42465, holotype, 51.1 mm SL, Brazil, Bahia, rio Mucujê (rio Paraguaçu drainage); *G. spinosum*: MZUSP 99742, holotype, 58.1 mm SL, Brazil, Bahia, riacho at Gruna dos Torras (rio Paraguaçu drainage). Trichogeninae: *Trichogenes claviger*: MZUSP 105372, 4, paratypes, 39.7-40.1 mm SL, Brazil, Espírito Santo, córrego Picada Comprida (rio Itapemerim

drainage); *T. longipinnis*: MZUSP 16099, holotype, 64.4 mm SL, Brazil, São Paulo, cachoeira do Amor. Trichomycterinae: *Bullockia maldonadoi*: FML uncat., 2, 31.2-30.7 mm SL, Argentina, río Andalion; *Eremophilus mutisii*: FML uncat., 2, 190.0-200.8 mm SL, Colômbia; *Hatcheria macraei*: FML uncat., 1, 78.2 mm SL, Argentina, Neuquén, arroyo Picún Leufú; *Silvinichthys bortayro*: MZUSP 83359, 1, paratype, 27.7 mm SL, Argentina, Salta, artificial well near río Arenales at San Luis; *S. mendozensis*: MZUSP 75189, 1, 44,5 mm SL, Argentina, Lujan de Cuyo, río Salto; *T. albinotatus*: MZUSP 42312, holotype, 45.3 mm SL, Brazil, Rio de Janeiro, rio Preto (rio Paraiba do Sul drainage); *T. alternatus*: MZUSP 54166, 4, 39.9-59.8 mm SL, Brazil, São Paulo, rio Boissucanga; *T. alterus*: FML 2085, 1, 49.4 mm SL, Argentina, La Rioja, Andalucas; *T. areolatus*: UFRGS 10792, 4, 33.1-54.4 mm SL, Chile, Província de Cautín, río Allipen; *T. auroguttatus*: MZUSP 43341, holotype, 49.7 mm SL, Brazil, Rio de Janeiro, rio Marimbondo (rio Paraíba do Sul drainage); MZUSP 43342, 4, paratypes, 33.6-47.3 mm SL, collected with the holotype; *T. bahianus*: MZUSP 43340, holotype, 68.0 mm SL, Brazil, Bahia, riacho tributary of the ribeirão Caveira (rio Una drainage); MZUSP 38636, 4, paratypes, 44.9-87.3 mm SL, collected with the holotype; *T. barbouri*: FML 4742, 63.6-75.6 mm SL, Argentina,Salta, río Calchaqui (río Juramento drainage); *T. belensis*: FML 2530, holotype, 63.7 mm SL, Argentina, Catamarca, stream tributary to Laguna Branca; FML 2531, 3, paratypes, 40.8-59.6 mm SL, collected with the holotype; *T. borelli*: MZUSP 2208, 1, 57.8 mm SL, Argentina, rio Mendoza; *T. boylei*: FML uncat., 3, 38.0-53.3 mm SL, Argentina, Jujuy, arroyo near Tres Cruces; *T. castroi*: MZUSP 36964, holotype, 118.3 mm SL, Brazil, Paraná, branch of the rio Iguaçu (rio Paraná drainage); *T. catamarcensis*: FML 2507, holotype, 36.5 mm SL, Argentina, Catamarca, stream tributary to Laguna Branca; FML 2508: 4, paratypes, 32.5-35.2 mm SL, collected with the holotype; *T. concolor*: MZUSP 43347, holotype, 62.8 mm SL, Brazil, Minas Gerais, stream 20 km south of Garapuava (rio São Francisco drainage); *T. corduvensis*: FML 2463, 2, 57.7-79.5 mm SL, Argentina, Catamarca, río Protero; *T. crassicaudatus*: MZUSP 88518, holotype, 109.2 mm SL, Brazil, Paraná, rio Jordão (rio Paraná drainage); *T. diabolus*: MZUSP 78860, holotype, 53.7 mm SL, Brazil, São Paulo, córrego São Carlos (rio Paranapanema drainage); *T. guianensis*: MZUSP 109099, 4, 62.7-85.0 mm SL, Guiana, rio Kuribrong (Essequibo drainage); *T. hasemani*: MZUSP 93953, 2, 13.7-13.8 mm SL, Brazil, Amazonas, igarapé Boiboi (rio

Negro drainage); *T. hualco*: FML 2601, holotype, 68.3 mm SL, Argentina, La Rioja, río Hualco; *T. igobi*: MZUSP 94843, 3, paratypes, 82.3-88.9 mm SL, Brazil, Paraná, rio Jordão (rio Paraná drainage); *T. itacambirussu*: MZUSP 58493, holotype, 70.9 mm SL, Brazil, Minas Gerais, córrego do Cabral (rio Jequitinhonha drainage); *T. itacarambiensis*: MZUSP 42649, holotype, 47.2 mm SL, Brazil, Minas Gerais, Olhos d'Água cave (rio São Francisco drainage); *T. jequitinhonhae*: MZUSP 58497, holotype, 70.5 mm SL, Brazil, Minas Gerais, córrego Laranjeiras (rio Jequitinhonha drainage); *T. johnsoni*: MZUSP 95013, 2, 13.1-14.5 mm SL, Brazil, Mato Grosso, rio Mutum (rio Paraguay drainage); *T. landinga*: MZUSP 58496, holotype, 43.3 mm SL, Brazil, Minas Gerais, córrego Moquém (rio Jequitinhonha drainage); *T. longibarbatus*: MZUSP 43339, holotype, 57.9 mm SL, Brazil, Espírito Santo, near village Santa Tereza; *T. mboycy*: MZUSP 94956, 1, 68.6 mm SL, Brazil, Paraná, rio Jordão (rio Paraná drainage); *T. mimonha*: MZUSP 43343, holotype, 56.2 mm SL, Brazil, São Paulo, rio Benfica (rio Paraiba do Sul drainage); *T. mirissumba*: MZUSP 43345, holotype, 57.7 mm SL, Brazil, Rio de Janeiro, rio Preto (rio Paraiba do Sul drainage); *T. naipi*: UFRGS 11405, 4, 55.6-65.6 mm SL, Brazil, Paraná, arroio Passo do Pano (rio Paraná drainage); *T. paolence*: MZUSP 108930, 3, 51.8-83.9 mm SL, Brazil, São Paulo, riacho tributary to Guarapiranga reservoir (Paraná drainage); *T. paquequerense*: MZUSP 53755, 4, 25.2-61.5 mm SL, Brazil, Rio de Janeiro, ribeirão dos Andradas tributary to rio Paquequerensis; *T. plumbeus*: UFRGS 13947, 1, 62.5 mm SL, unnamed stream, rio Negro basin (rio Paraná drainage); *T. pseudosilvinichthys*: FML 2588, holotype, 60.6 mm SL, Argentina, La Rioja, río Amarillo; *T. ramosus*: FML 2070, holotype, 59.0 mm SL, Argentina, Catamarca, Laguna Branca; FML 2071, 5, paratypes, 60.2-64.3 mm SL, collected with the holotype; *T. reinhardti*: MZUSP 94511, 4, 47.7-70.14 mm SL, Brazil, Minas Gerais, rio Itabira (rio São Francisco drainage); *T. roigi*: FML 1503, 2, 51.1-61.4 mm SL, Argentina, Jujuy, arroyo 4 km north of Orosmayo; *T. spegazzinii*: FML 4747, 3, 35.8-89.1 mm SL, Argentina, Salta, río Calchaquí (Juramento drainage); *T. taczanowoskii*: MZUSP 26031, 1, 100.6 mm SL, Peru, rio Chiriaco; *T. tupinamba*: MZUSP 61686, 2, 50.3-54.8 mm SL, Brazil, São Paulo, rio Betari (rio Ribeira do Iguape drainage); *T. variegatus*: MZUSP 42316, holotype, 39.8 mm SL, Brazil, Minas Gerais, rio do Peixe (rio São Francisco drainage); *T. vermiculatus*: MZUSP 87189, 4, 36.1-99.1 mm SL, Brazil, Minas Gerais, córrego Içara (rio Paraná drainage); *T. yuska*: FML 2535, holotype, 88.6 mm SL,

Argentina, Catamarca, arroyo Aguas Calientes; *Trichomycterus* sp. n. 1: MCP 46701, 1, 48.9 mm SL, Brazil, Rio Grande do Sul, unnamed stream tributary of Erechim River (rio Uruguay drainage); MCP 46711, 1, 69.1 mm SL, Brazil, Rio Grande do Sul, unnamed stream tributary of Sepultura Stream, an affluent of reservoir of the Passo Fundo Hydroelectric Power Plant (rio Uruguay drainage); *Trichomycterus* sp. n. 2: MZUSP 25022, 7 (c&s), Brazil, Santa Catarina, rio Roseira (rio Uruguay drainage); *Trichomycterus* sp.: UFRGS 11312, 9 (1 c&s), 63.0-86.5 mm SL, Brazil, Rio Grande do Sul, rio Ijuí (rio Uruguay drainage); UFRGS 9492, 5 (1 c&s), 48.0-73.7 mm SL, Brazil, Rio Grande do Sul, arroio Lajeadinho (rio Uruguay drainage); MCP 17440, 5 (1 c&s), 30.2-61.5 mm SL, Brazil, Rio Grande do Sul, stream tributary of rio dos Touros (rio Uruguay drainage); UFRGS 10651, 1 (c&s), 66.5 mm SL, Brazil, Rio Grande do Sul, rio Cerrito (rio Tramandaí drainage); MCN 18587, 1, 63.0 mm SL, Brazil, Rio Grande do Sul, arroio Carvalho tributary of rio Maquine (rio Tramandaí drainage). *Ituglanis bambui*: MZUSP 79860, holotype, 41.7 mm SL, Brazil, Goiás, stream at Angelica Cave; *I. macunaima*: MZUSP 88452, holotype, 30.7 mm SL, Brazil, Mato Grosso, Corixo da Saudade (rio Araguaia drainage); *I. ramiroi*: MZUSP 79865, holotype, 28.1 mm SL, Brazil, Goiás, side pool fed by small water inlet at São Bernardo Cave. Additional comparative material in Ferrer & Malabarba (2011).

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Table 1. Morphometric data for holotype and paratypes of *Trichomycterus* sp. A.

	Holotype	Range	Mean	SD	N
Standard length (mm)	82.0	27.3-100.9	63.15	-	102
Percents of Standard Length					
Head length	18.0	19.5-25.7	21.6	0.98	102
Predorsal length	54.8	62.3-67.8	65.9	1.11	102
Prepelvic length	49.0	55.9-61.3	58.4	1.14	102
Preanal length	60.3	69.5-75.6	72.4	1.28	102
Scapular girdle width	12.4	13.4-18.9	15.3	0.71	102
Trunk length	31.5	34.9-41.4	38.8	1.06	102
Pectoral-fin length	10.0	10.6-14.5	12.3	0.77	102
Pelvic-fin length	7.3	7.1-10.7	8.4	0.61	102
Distance between pelvic-fin base and anus	7.8	8.1-11.9	9.9	0.74	102
Caudal peduncule length	13.7	16.5-22.3	19.3	1.00	102
Caudal peduncule depth	9.00	10.1-13.7	11.3	0.62	102
Body depth	12.6	10.8-17.6	14.2	1.05	100
Length of dorsal-fin base	9.1	8.6-12.7	10.9	0.72	102
Length of anal-fin base	7.5	6.9-10.5	8.7	0.67	102
Percents of Head Length					
Head width	15.0	76.4-89.1	82.5	2.76	102
Nasal barbel length	8.0	35.0-62.9	49.3	5.74	102
Maxillary barbel length	7.9	37.8-66.6	53.3	6.67	102
Rictal barbel length	7.7	31.9-59.8	47.8	6.26	102
Snout length	8.1	40.2-48.2	44.9	1.85	102
Interorbital	4.0	17.8-26.3	22.2	1.77	102
Mouth width	8.1	33.7-50.3	43.4	3.08	102
Eye diameter	1.5	6.8-15.2	9.6	1.55	102
Supra-orbital pore distance	1.8	4.4-16.9	9.4	2.35	101

Table 2. Morphometric data for holotype and paratypes of *Trichomycterus* sp. B.

	Holotype	Range	Mean	SD	N
Standard length (mm)	58.8	25.8-68.3	50.1	-	18
Percents of Standard Length					
Head length	12.9	19.9-24.0	22.7	1.02	18
Predorsal length	36.6	61.8-67.0	64.6	1.40	18
Prepelvic length	33.1	56.0-59.3	57.7	0.91	18
Preanal length	41.8	67.6-74.0	71.9	1.48	18
Scapular girdle width	9.3	14.9-17.3	16.1	0.65	18
Trunk length	21.5	35.4-41.0	37.7	1.27	18
Pectoral-fin length	7.5	11.8-14.5	13.2	0.75	18
Pelvic-fin length	5.0	8.2-9.6	9.0	0.44	18
Distance between pelvic-fin base and anus	5.8	8.6-10.3	9.6	0.48	18
Caudal peduncule length	11.1	18.3-21.9	19.4	1.05	18
Caudal peduncule depth	7.5	11.5-14.3	12.7	0.77	18
Body depth	9.6	14.2-18.0	16.0	0.94	18
Length of dorsal-fin base	7.1	10.3-12.5	11.6	0.61	18
Length of anal-fin base	5.3	7.9-9.7	8.5	0.46	18
Percents of Head Length					
Head width	10.6	74.1-93.8	82.4	4.12	18
Nasal barbel length	5.4	38.3-51.6	43.9	3.33	18
Maxillary barbel length	6.9	38.3-53.9	48.9	4.07	17
Rictal barbel length	6.9	42.7-53.5	47.5	3.02	18
Snout length	5.2	40.5-45.3	43.4	1.36	18
Interorbital	2.9	19.0-25.3	21.9	1.60	18
Mouth width	5.6	43.9-52.5	47.7	2.41	18
Eye diameter	1.1	7.8-12.6	10.1	1.49	18
Supra-orbital pore distance	1.4	6.8-14.0	11.1	2.17	17

Table 3. Morphometric data for holotype and paratypes of *Trichomycterus* sp. C.

	Holotype	Range	Mean	SD	N
Standard length (mm)	63.3	29.1-92.5	55.4	-	77
Percents of Standard Length					
Head length	18.5	17.5-21.8	19.7	0.92	77
Predorsal length	66.3	63.6-70.1	66.5	1.37	77
Prepelvic length	55.5	54.0-60.5	57.5	1.34	77
Preanal length	71.2	68.3-76.3	71.4	1.30	77
Scapular girdle width	13.5	13.0-15.4	14.0	0.60	76
Trunk length	39.0	36.5-43.1	39.6	1.47	77
Pectoral-fin length	10.7	9.9-13.8	11.7	0.88	77
Pelvic-fin length	7.8	6.9-9.5	8.2	0.52	77
Distance between pelvic-fin base and anus	9.7	7.2-10.9	8.9	0.86	77
Caudal peduncule length	20.1	18.6-23.1	20.9	0.88	77
Caudal peduncule depth	12.4	9.3-14.7	12.1	0.98	77
Body depth	14.0	11.6-16.4	14.1	0.91	77
Length of dorsal-fin base	11.6	7.1-12.2	10.7	0.77	77
Length of anal-fin base	9.1	6.9-9.5	8.3	0.54	77
Percents of Head Length					
Head width	82.0	75.3-94.5	83.2	3.61	77
Nasal barbel length	51.8	37.8-62.3	51.2	5.05	77
Maxillary barbel length	52.4	33.2-60.4	51.9	6.12	77
Rictal barbel length	53.3	34.1-66.6	50.3	6.19	77
Snout length	41.4	35.7-42.7	39.8	1.78	76
Interorbital	19.8	17.1-25.9	21.6	1.79	76
Mouth width	46.0	35.5-53.5	43.8	3.62	77
Eye diameter	10.6	6.8-14.1	10.5	1.62	77
Supra-orbital pore distance	11.8	7.3-16.3	12.2	1.87	76

Table 4. Morphometric data for holotype and paratypes of *Trichomycterus* sp. D.

	Holotype	Range	Mean	SD	N
Standard length (mm)	61.1	26.3-70.9	46.4	-	15
Percents of Standard Length					
Head length	20.4	19.9-24.0	21.6	1.10	15
Predorsal length	65.0	62.9-66.7	65.1	1.09	15
Prepelvic length	55.4	55.4-58.1	56.7	0.92	15
Preanal length	69.7	69.0-72.8	71.0	1.16	15
Scapular girdle width	13.6	13.6-15.6	14.7	0.67	14
Trunk length	35.6	34.2-37.8	36.3	1.21	15
Pectoral-fin length	13.7	12.9-15.6	14.3	0.72	15
Pelvic-fin length	9.7	9.1-10.8	9.9	0.41	15
Distance between pelvic-fin base and anus	11.5	9.8-11.7	10.6	0.66	15
Caudal peduncule length	19.6	18.3-21.8	20.1	0.81	15
Caudal peduncule depth	9.9	9.9-12.5	11.5	0.81	15
Body depth	12.8	12.6-19.6	14.8	1.86	15
Length of dorsal-fin base	12.6	10.5-12.7	11.6	0.69	15
Length of anal-fin base	8.0	7.3-10.4	9.0	0.89	15
Percents of Head Length					
Head width	85.5	79.5-89.6	83.9	3.17	15
Nasal barbel length	72.6	55.3-74.3	66.2	6.41	14
Maxillary barbel length	73.0	68.2-87.7	78.9	5.57	15
Rictal barbel length	71.8	56.5-79.3	69.7	6.36	15
Snout length	42.6	38.1-42.6	40.2	1.35	14
Interorbital	21.9	18.3-23.3	21.2	1.33	15
Mouth width	52.8	45.0-52.8	48.6	2.10	15
Eye diameter	10.0	7.9-11.2	9.5	0.84	15
Supra-orbital pore distance	10.6	10.2-16.1	12.7	2.11	15

Fig. 1. *Trichomycterus* sp. A, holotype, UFRGS uncat., 82.0 mm SL, Brazil, State of Rio Grande do Sul, Municipality of São Francisco de Paula, rio Santa Cruz, rio Caí basin.

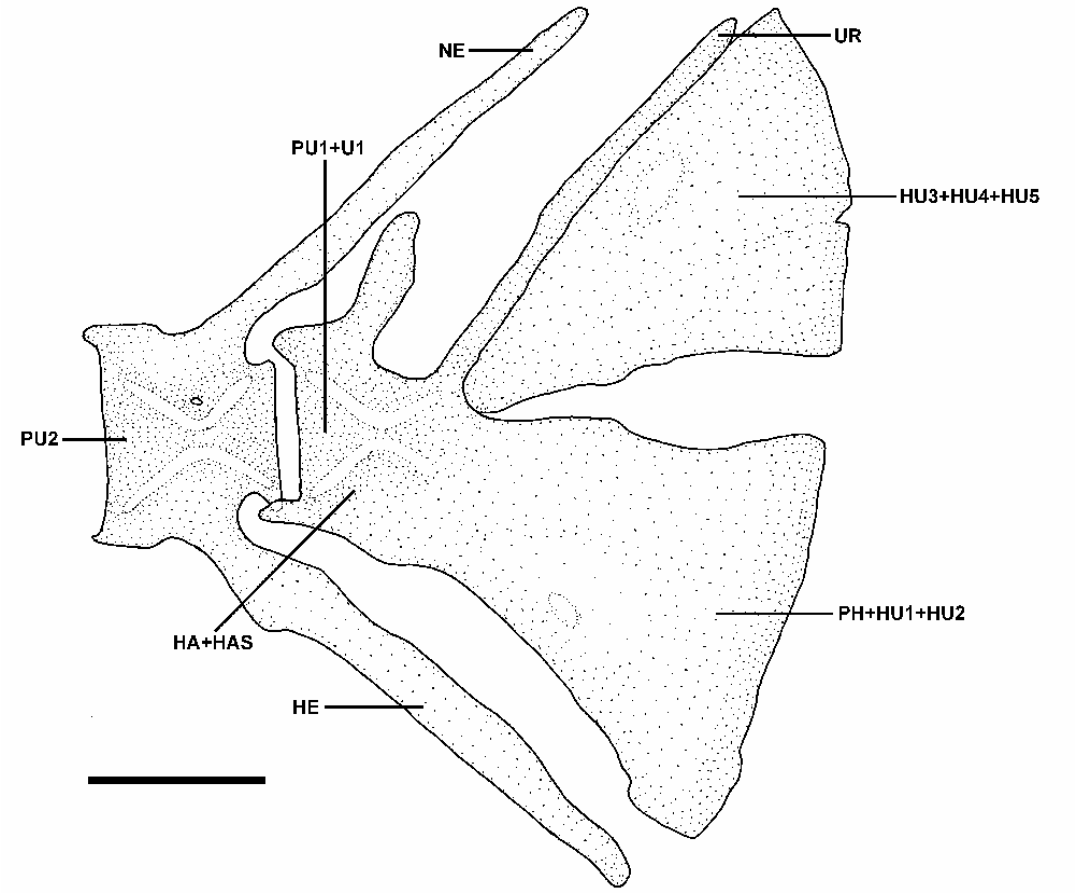

Fig. 2. Caudal skeleton of *Trichomycterus* sp. A, paratype, UFRGS 6831 (81.7 mm SL), lateral view. Abbreviations: HA+HAS, complex hypurapophysis composed of hypurapophysis and secondary hypurapophysis; HE, hemal spine; HU3+HU4+HU5, complex plate formed by co-ossification of hypurals 3 to 5; NE, neural spine; PH+HU1+HU2, complex plate formed by co-ossification of hypurals 1 and 2 and parhypural; PU1+U1, complex centrum composed of preural centrum 1 and ural centrum 1; PU2, preural centrum; UR, uroneural. Scale bar = 1 mm.

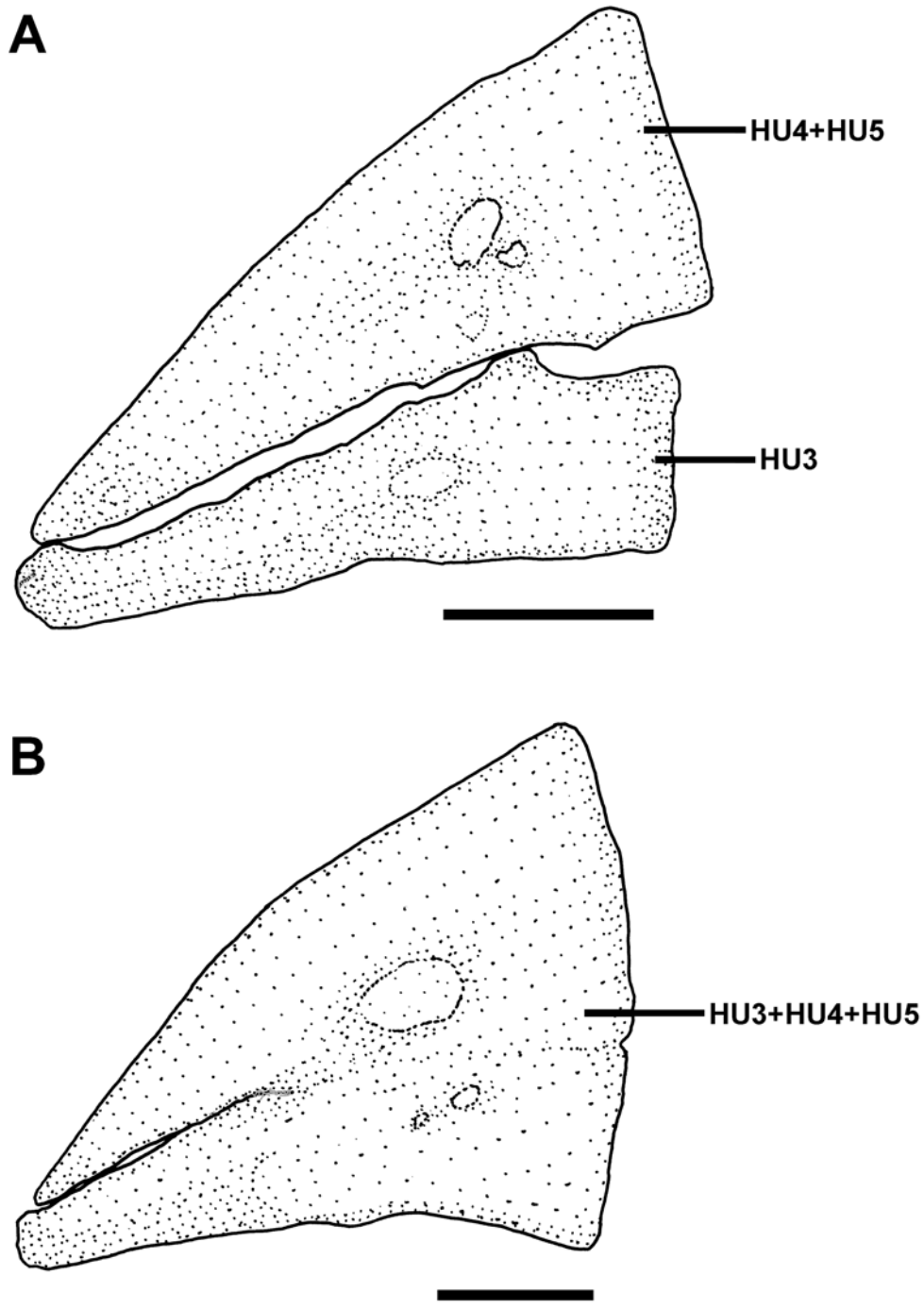

Fig. 3. Upper caudal plates of *Trichomycterus* sp. A., lateral view. A = paratype, MCP 41292 (64.7 mm SL); B = paratype, MCP 41292 (72.3 mm SL). Abbreviations: HU3, hypural 3; HU4+HU5, complex plate formed by co-ossification of hypurals 4 and 5; HU3+HU4+HU5, complex plate formed by co-ossification of hypurals 3, 4 and 5. Scale bar = 0.5 mm.

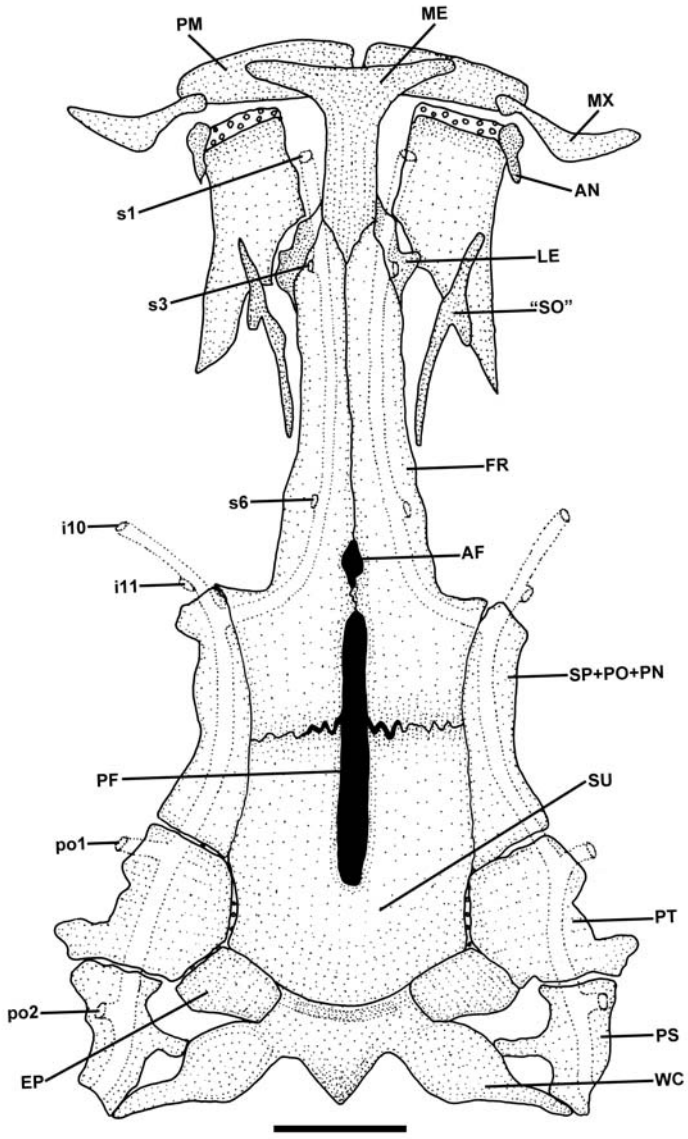

Fig. 4. Neorocranium of *Trichomycterus* sp. A, paratype, UFRGS 6831 (81.7 mm SL), dorsal view. Abbreviations: AF, anterior fontanel; AN, antorbital; AP, autopalatine; EP, epioccipital; FR, frontal; LE, lateral ethmoid; i10-11, infraorbital sensory branch 10 and 11; ME, mesethmoid; MX, maxilla; PF, posterior fontanel; PM, premaxilla; po1-2, postotic sensory branches 1 and 2; PS, posttemporosupracleithrum; PT, pterotic; s1, supraorbital sensory branch 1; s3, supraorbital sensory branch 3; s6, supraorbital sensory branch 6 (epiphyseal branch); "SO", tendon-bone supraorbital; SP+PO+PN, sphenotic-prootic-pterosphenotic complex bone; SU, parieto-supraoccipital; WC, Weberian capsule. Scale bar = 2 mm.

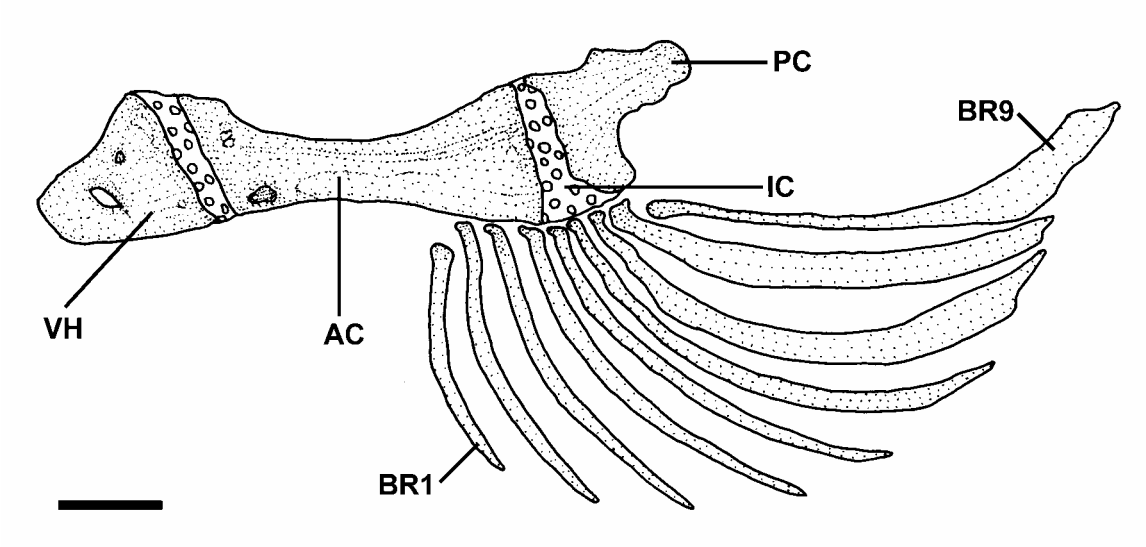

Fig. 5. Left hyoid arch of *Trichomycterus* sp. A, paratype, UFRGS 6831 (81.7 mm SL), lateral view. Abbreviations: AC, anterior ceratohyal; BR1-9, branchiostegal rays 1 to 9; IC, inter-ceratohyal cartilage; PC, posterior ceratohyal; VH, ventral hypohyal. Scale bar = 1 mm.

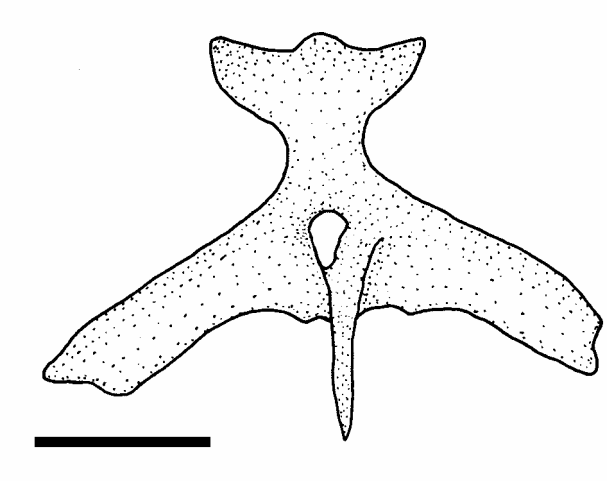

Fig. 6. Urohyal of *Trichomycterus* sp. A, paratype, UFRGS 6831 (81.7 mm SL), dorsal view.

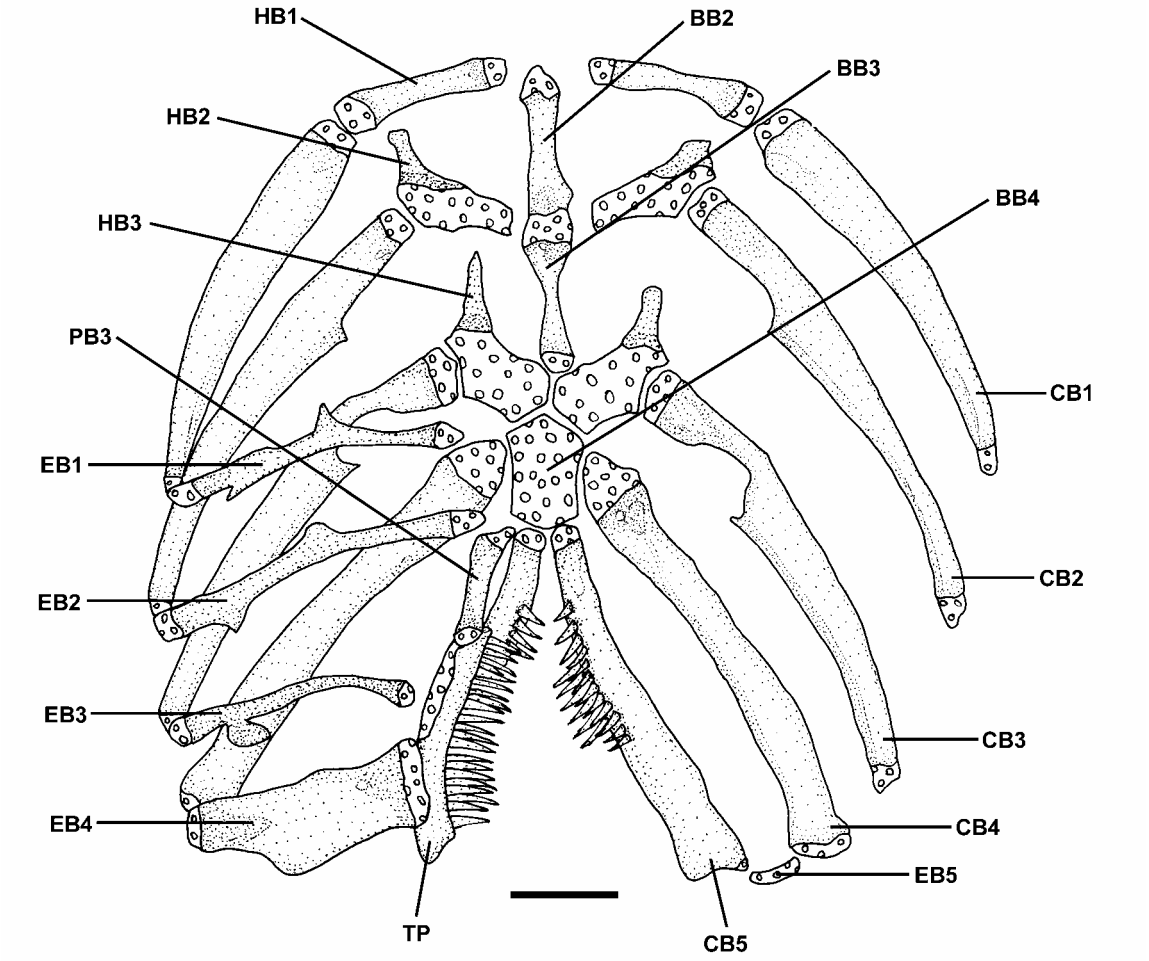

Fig. 7. Gill arches of *Trichomycterus* sp. A, paratype, UFRGS 6831 (81.7 mm SL), dorsal view, right dorsal elements and gill rakers not show. Abbreviations: BB2-4, basibranchials 2 to 4; CB1-5, ceratobranchials 1 to 5; EB1-5, epibranchials 1 to 5; HB1-3, hypobranchials 1 to 3; PB3, pharyngobranchial 3; TP; tooth plate. Scale bar = 1 mm.

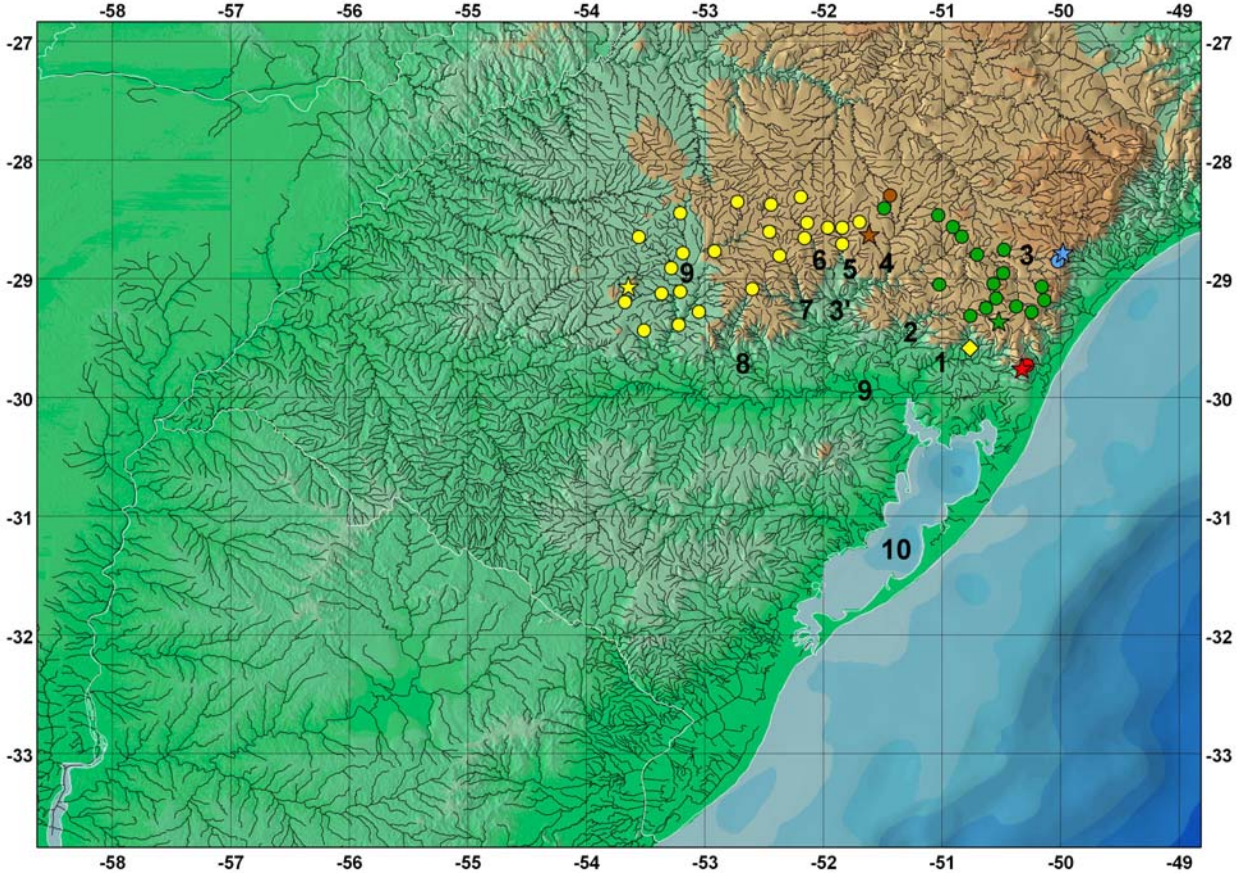

Fig. 8. Geographic distribution of *Trichomycterus* species. Some symbols represent more than one collection locality. Stars represent type-localities. *T. tropeiro* (blue symbols), *Trichomycterus* sp. A (green symbols), *Trichomycterus* sp. B (brown symbols), *Trichomycterus* sp. C (yellow symbols), *Trichomycterus* sp. D (red symbols); *Trichomycterus cf.* sp. C (yellow lozenge). Abbreviations: 1, rio dos Sinos; 2, rio Caí; 3, rio das Antas; 3', rio Taquari-Antas; 4, rio da Prata; 5, rio Carreiro; 6, rio Guaporé; 7, rio Forqueta; 8, rio Pardo; 9, rio Jacuí; 10, laguna dos Patos

Fig. 9. Locality where some types of *Trichomycterus* sp. A were collected: arroio Bagual, Municipality of Bom Jesus, Rio Grande do Sul, Brazil.

Fig. 10. *Trichomycterus* sp. B, holotype, MCP uncat., 58.8 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Nova Prata, rio da Prata at Passo do Despraiado.

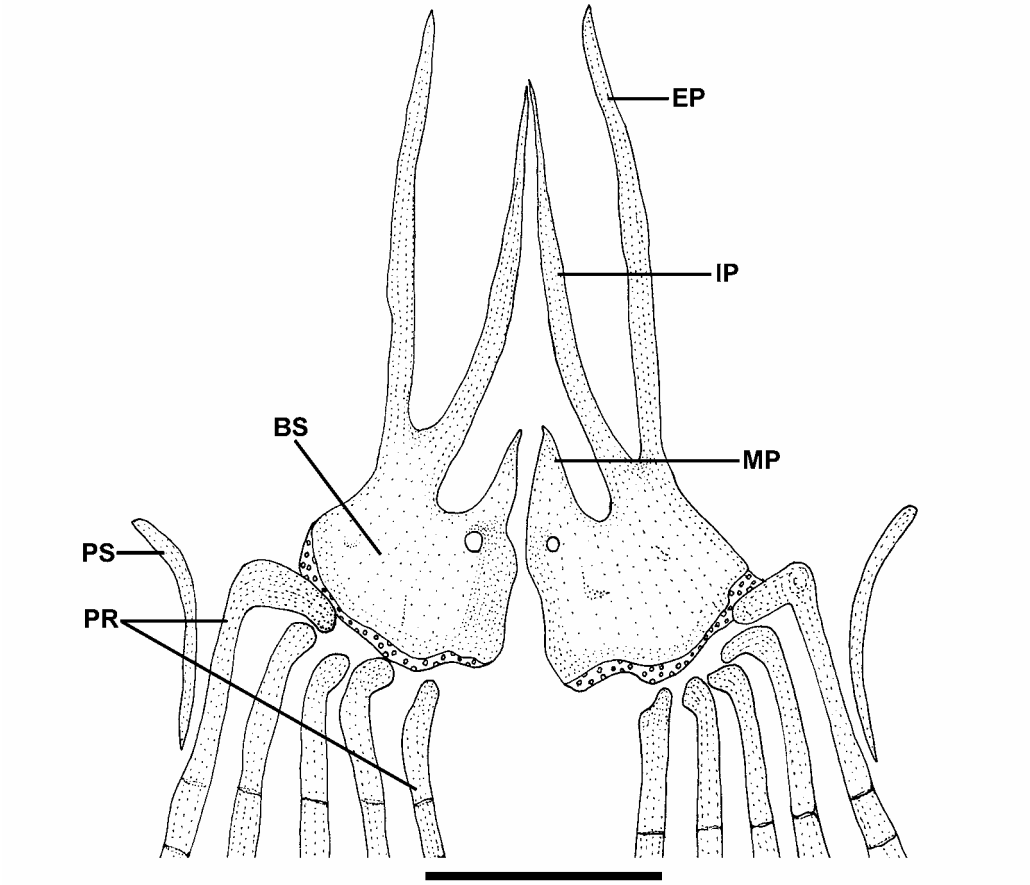

Fig. 11. Pelvic girdle of *Trichomycterus* sp. B, paratype, MCP 35050 (57.8 mm SL), dorsal view. Abbreviations: BS, basipterygium; EP, external process; IP, internal process; MP, medial process; PR, pelvic-fin rays; PS, pelvic splint. Scale bar = 1 mm.

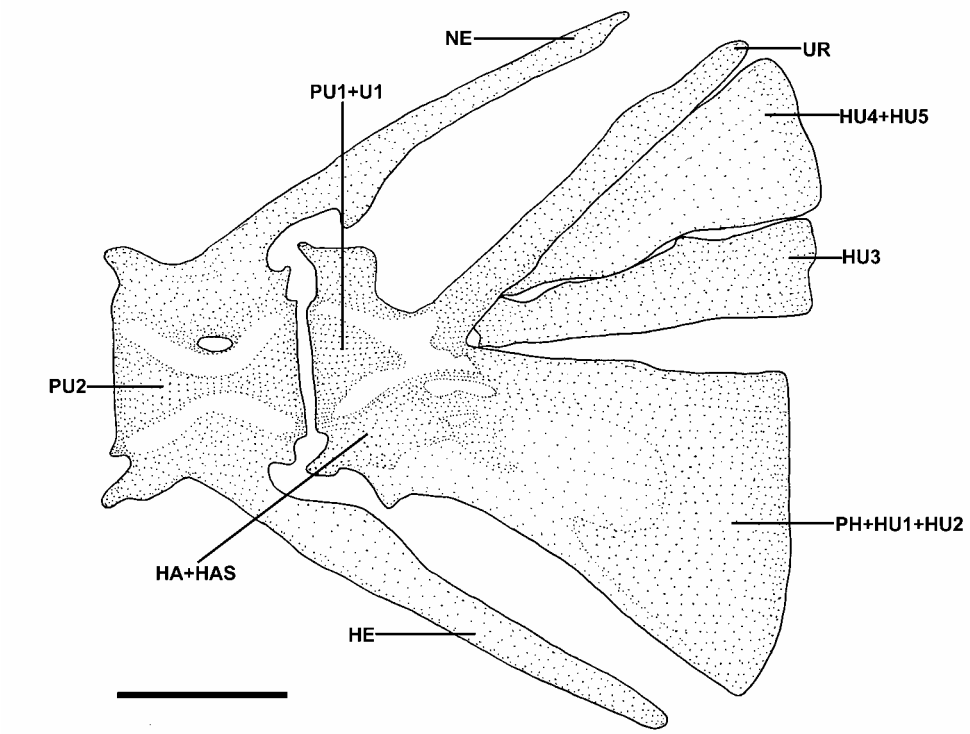

Fig. 12. Caudal skeleton of *Trichomycterus* sp. B, paratype, MCP 35050 (57.8 mm SL), lateral view. Abbreviations: HA+HAS, complex hypurapophysis composed of hypurapophysis and secondary hypurapophysis; HE, hemal spine; HU3, hypural 3; HU4+HU5, complex plate formed by co-ossification of hypurals 4 and 5; NE, neural spine; PH+HU1+HU2, complex plate formed by co-ossification of hypurals 1 and 2 and parhypural; PU1+U1, complex centrum composed of preural centrum 1 and ural centrum 1; PU2, preural centrum; UR, uroneural. Scale bar = 0.5 mm.

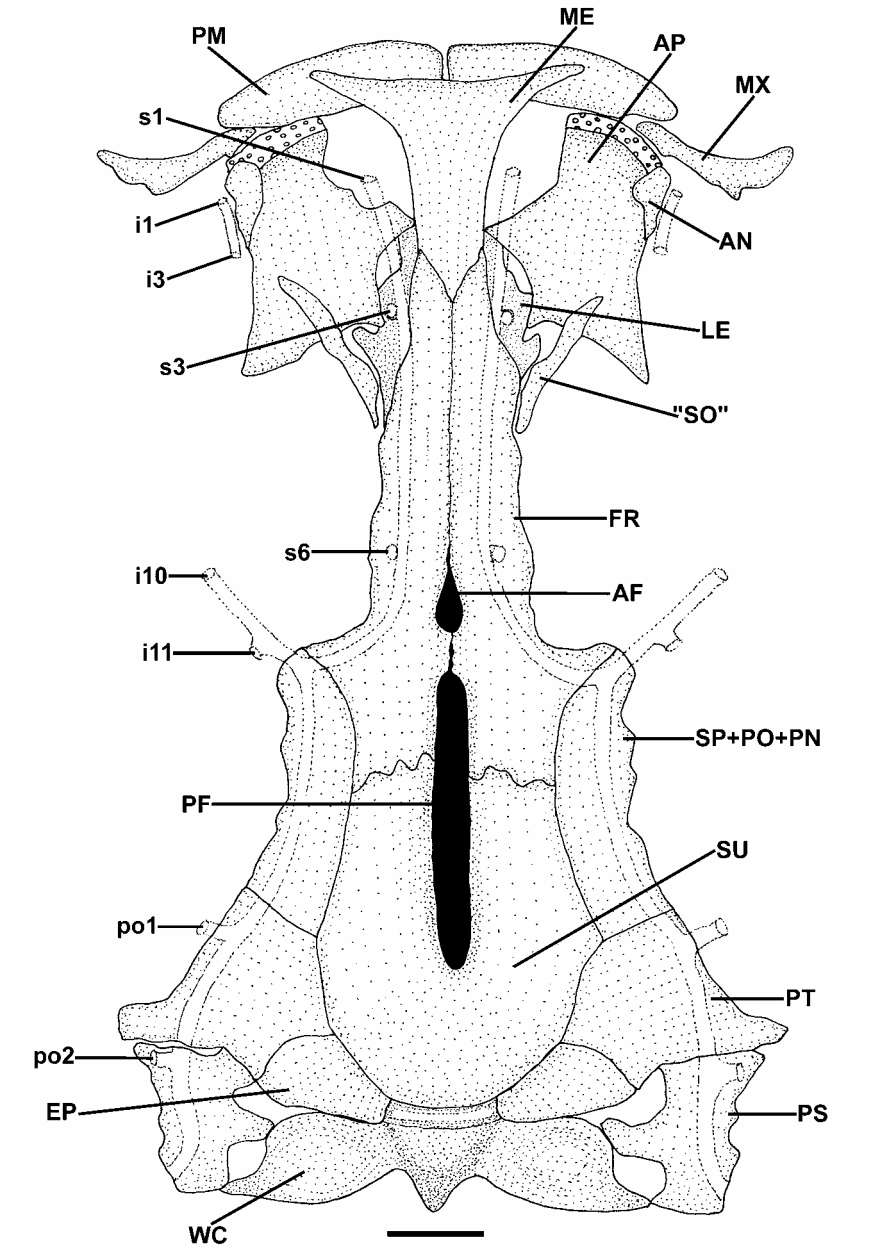

Fig. 13. Neorocranium of *Trichomycterus* sp. B, paratype, MCP 35050 (57.8 mm SL), dorsal view. Abbreviations: AF, anterior fontanel; AN, antorbital; AP, autopalatine; EP, epioccipital; FR, frontal; LE, lateral ethmoid; i1, infraorbital sensory branch 1; i3, infraorbital sensory branch 3; i10-11, infraorbital sensory branch 10 and 11; ME, mesethmoid; MX, maxilla; PF, posterior fontanel; PM, premaxilla; po1-2, postotic sensory branches 1 and 2; PS, posttemporosupracleithrum; PT, pterotic; s1, supraorbital sensory branch 1; s3, supraorbital sensory branch 3; s6, supraorbital sensory branch 6 (epiphyseal branch); "SO", tendon-bone supraorbital; SP+PO+PN, sphenotic-prootic-pterosphenotic complex bone; SU, parieto-supraoccipital; WC, Weberian capsule. Scale bar = 1 mm.

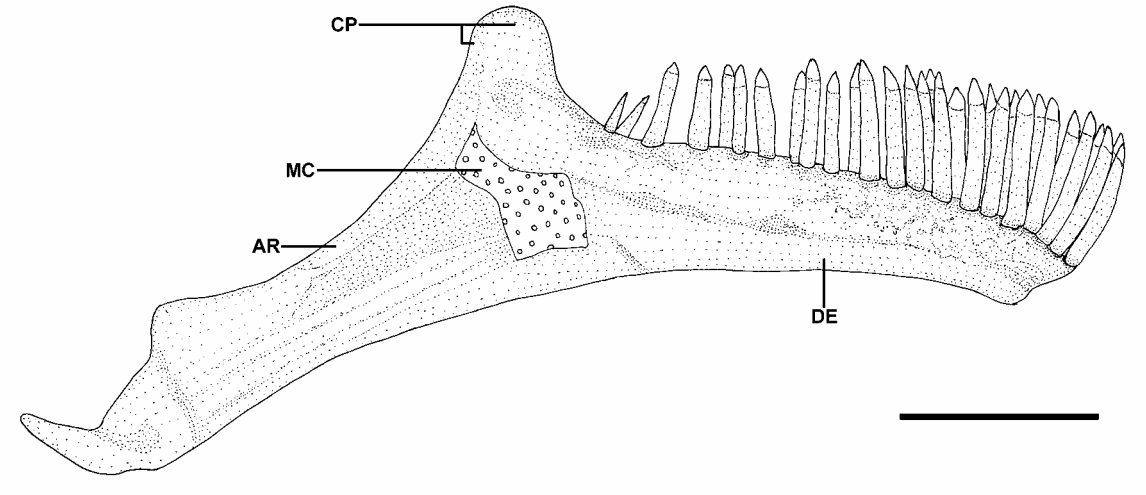

Fig. 14. Right mandible of *Trichomycterus* sp. B, paratype, MCP 35050 (57.8 mm SL), lateral view. Abbreviations: AR, anguloarticular; CP, coronoid process; DE, dentary; MC, Meckel's cartilage. Scale bar = 1 mm.

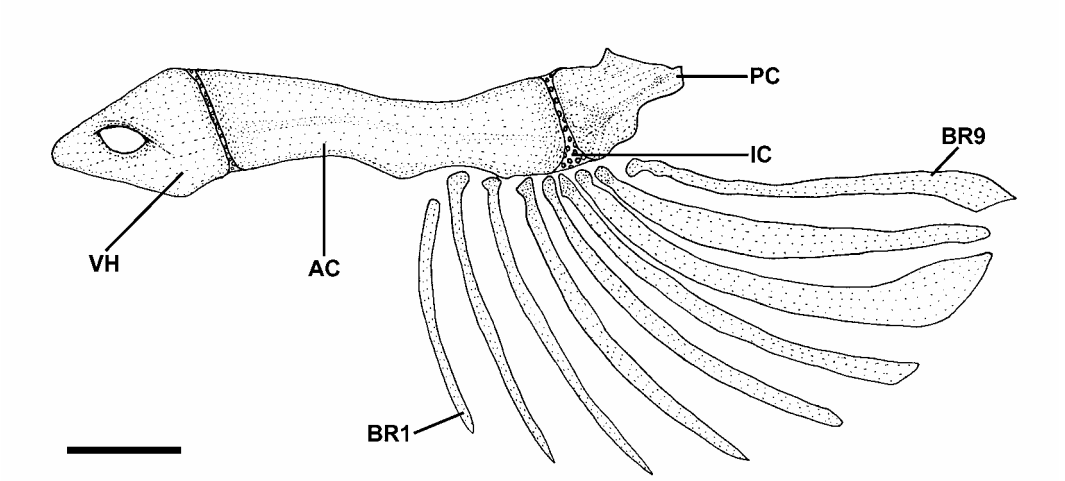

Fig. 15. Left hyoid arch of *Trichomycterus* sp. B, paratype, MCP 35050 (57.8 mm SL), lateral view. Abbreviations: AC, anterior ceratohyal; BR1-9, branchiostegal rays 1 to 9; IC, inter-ceratohyal cartilage; PC, posterior ceratohyal; VH, ventral hypohyal. Scale bar = 1 mm.

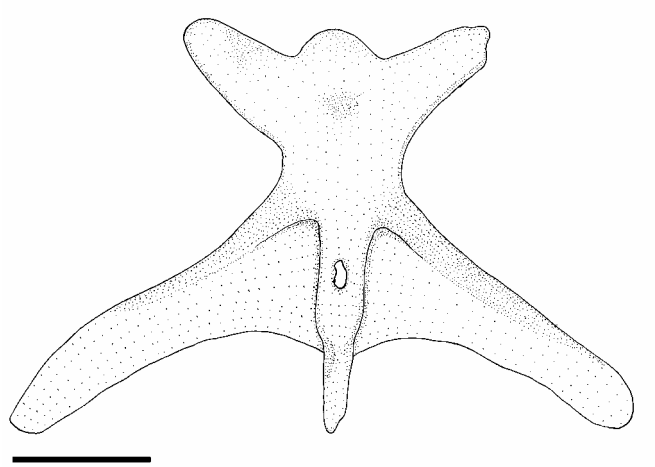

Fig. 16. Urohyal of *Trichomycterus* sp. B, paratype, MCP 35050 (57.8 mm SL), dorsal view. Scale bar = 0.5 mm.

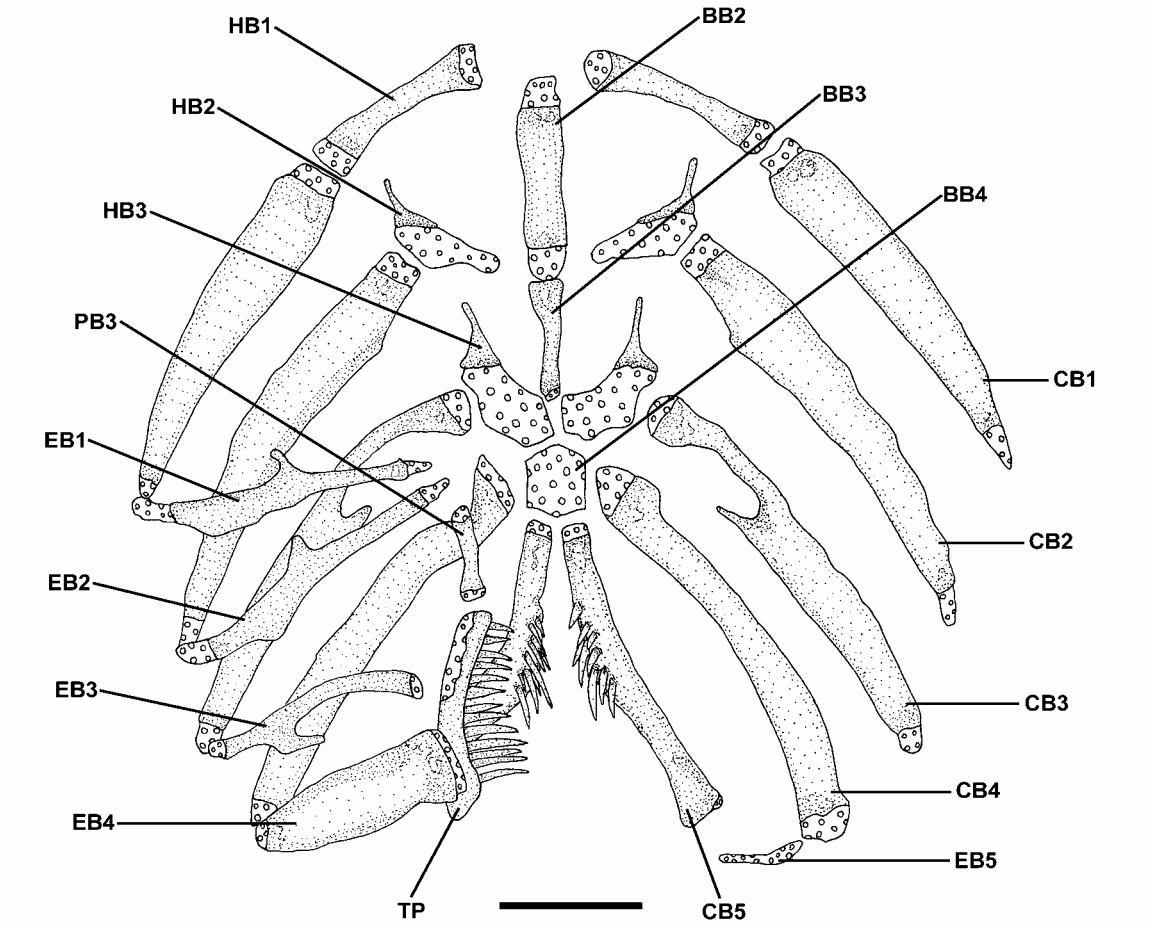

Fig. 17. Gill arches of *Trichomycterus* sp. B, paratype, MCP 35050 (57.8 mm SL), dorsal view, right dorsal elements and gill rakers not show. Abbreviations: BB2-4, basibranchials 2 to 4; CB1-5, ceratobranchials 1 to 5; EB1-5, epibranchials 1 to 5; HB1-3, hypobranchials 1 to 3; PB3, pharyngobranchial 3; TP; tooth plate. Scale bar = 1 mm.

Fig. 18. Type locality of *Trichomycterus* sp. B: rio da Prata at Passo do Despraiado, Municipality of Nova Prata, State of Rio Grande do Sul, Brazil. Photo: T. P. Carvalho.

Fig. 19. *Trichomycterus* sp. C, holotype, UFRGS uncat., 63.3 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Júlio de Castilhos, arroio Passo dos Buracos or Tipiaia on the road BR-158, Alto Jacuí basin.

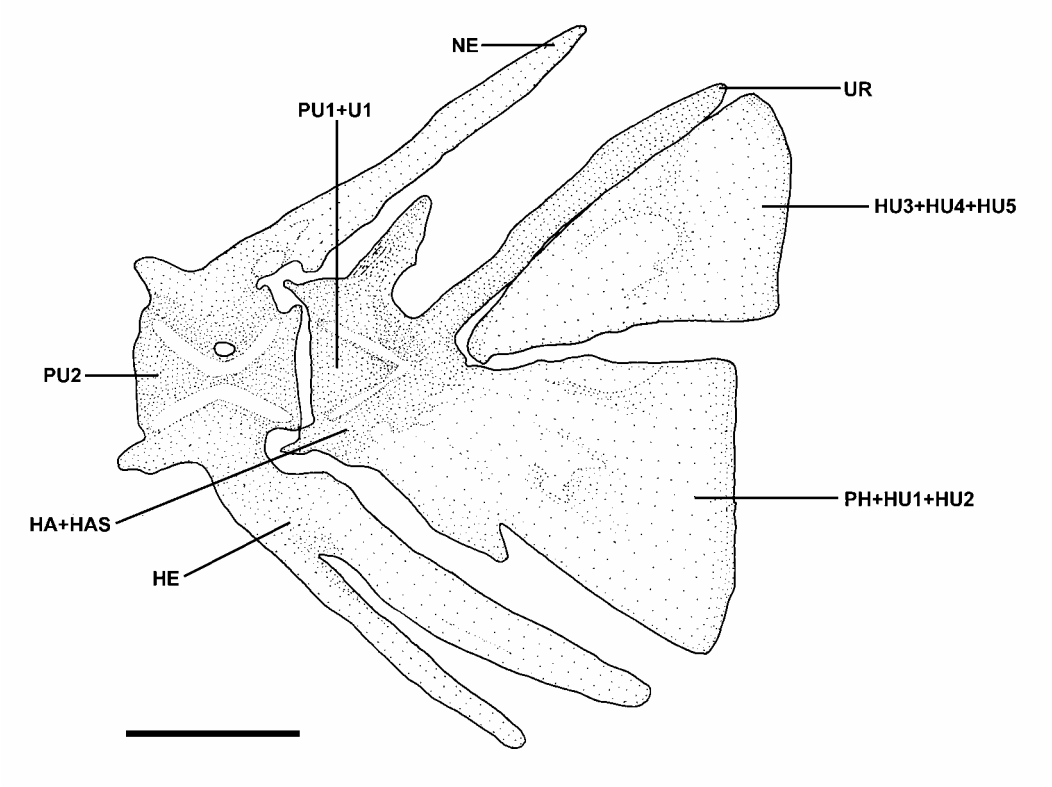

Fig. 20. Caudal skeleton of *Trichomycterus* sp. C, paratype, MCP 22699 (79.0 mm SL), lateral view. Abbreviations: HA+HAS, complex hypurapophysis composed of hypurapophysis and secondary hypurapophysis; HE, hemal spine; HU3+HU4+HU5, complex plate formed by co-ossification of hypurals 3 to 5; NE, neural spine; PH+HU1+HU2, complex plate formed by co-ossification of hypurals 1 and 2 and parhypural; PU1+U1, complex centrum composed of preural centrum 1 and ural centrum 1; PU2, preural centrum; UR, uroneural. Scale bar = 1 mm.

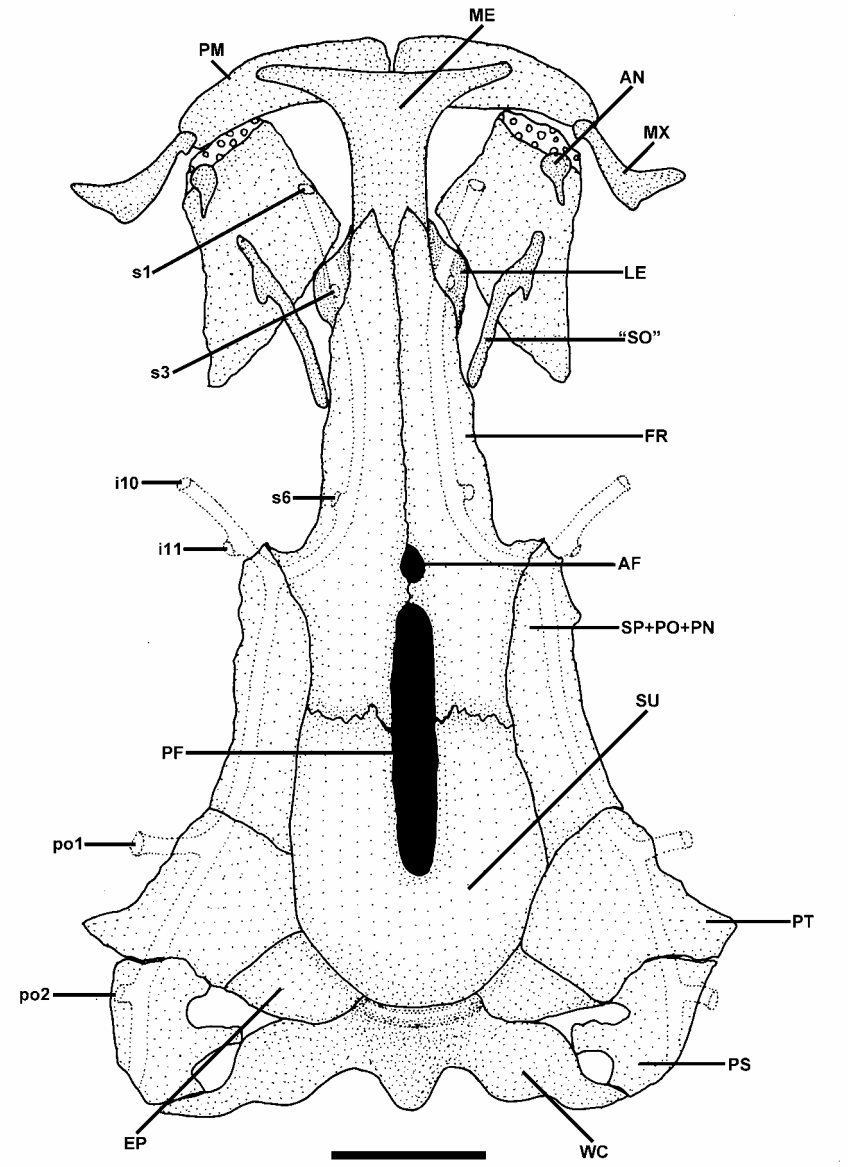

Fig. 21. Neorocranium of *Trichomycterus* sp. C, paratype, MCP 22699 (79.0 mm SL), dorsal view. Abbreviations: AF, anterior fontanel; AN, antorbital; AP, autopalatine; EP, epioccipital; FR, frontal; LE, lateral ethmoid; i10-11, infraorbital sensory branch 10 and 11; ME, mesethmoid; MX, maxilla; PF, posterior fontanel; PM, premaxilla; po1-2, postotic sensory branches 1 and 2; PS, posttemporosupracleithrum; PT, pterotic; s1, supraorbital sensory branch 1; s3, supraorbital sensory branch 3; s6, supraorbital sensory branch 6 (epiphyseal branch); "SO", tendon-bone supraorbital; SP+PO+PN, sphenotic-prootic-pterosphenotic complex bone; SU, parieto-supraoccipital; WC, Weberian capsule. Scale bar = 2 mm.

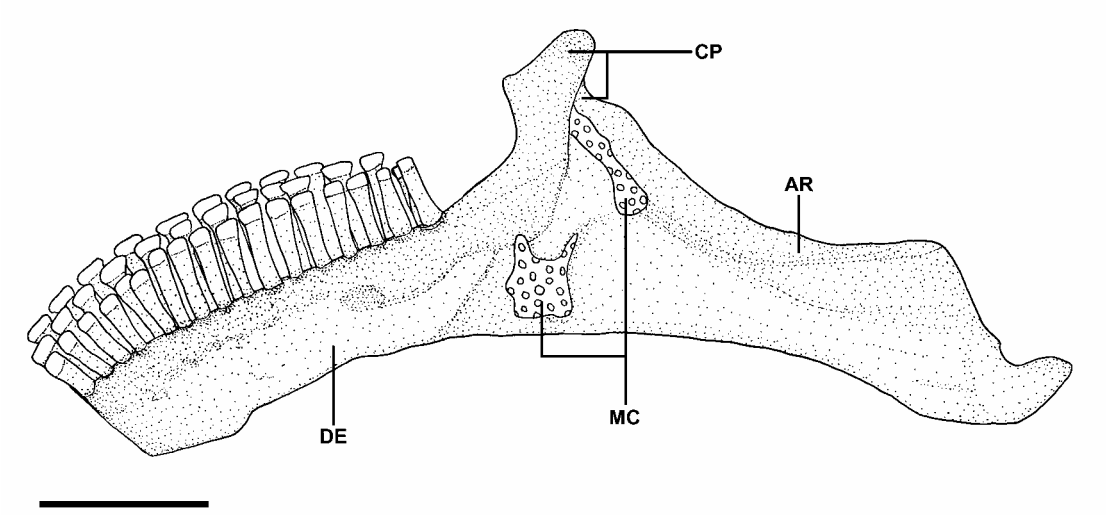

Fig. 22. Right mandible of *Trichomycterus* sp. C, paratype, MCP 22699 (79.0 mm SL), medial view. Abbreviations: AR, anguloarticular; CP, coronoid process; DE, dentary; MC, Meckel's cartilage. Scale bar = 1 mm.

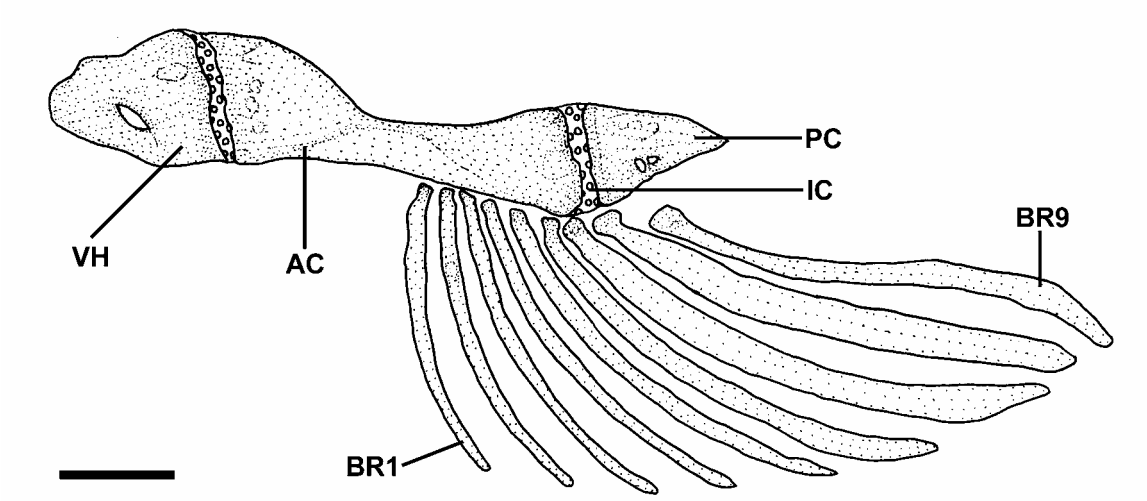

Fig. 23. Left hyoid arch of *Trichomycterus* sp. C, paratype, MCP 22699 (79.0 mm SL), lateral view. Abbreviations: AC, anterior ceratohyal; BR1-9, branchiostegal rays 1 to 9; IC, inter-ceratohyal cartilage; PC, posterior ceratohyal; VH, ventral hypohyal. Scale bar = 1 mm.

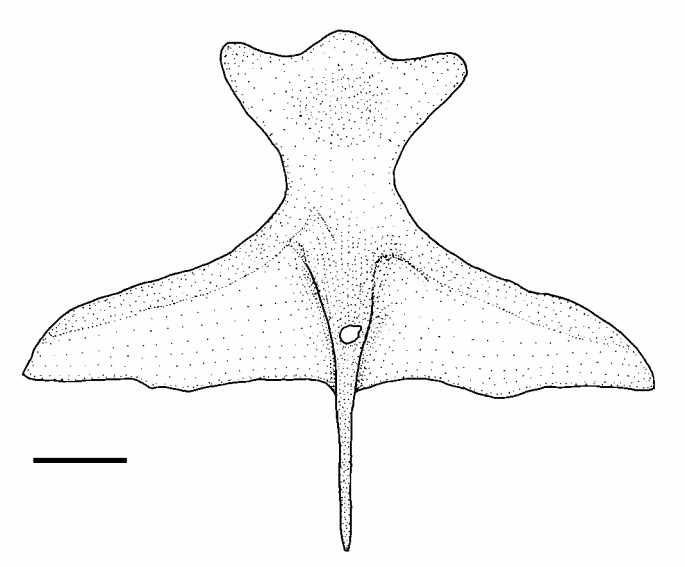

Fig. 24. Urohyal of *Trichomycterus* sp. C, paratype, MCP 22699 (79.0 mm SL), dorsal view. Scale bar = 0.5 mm.

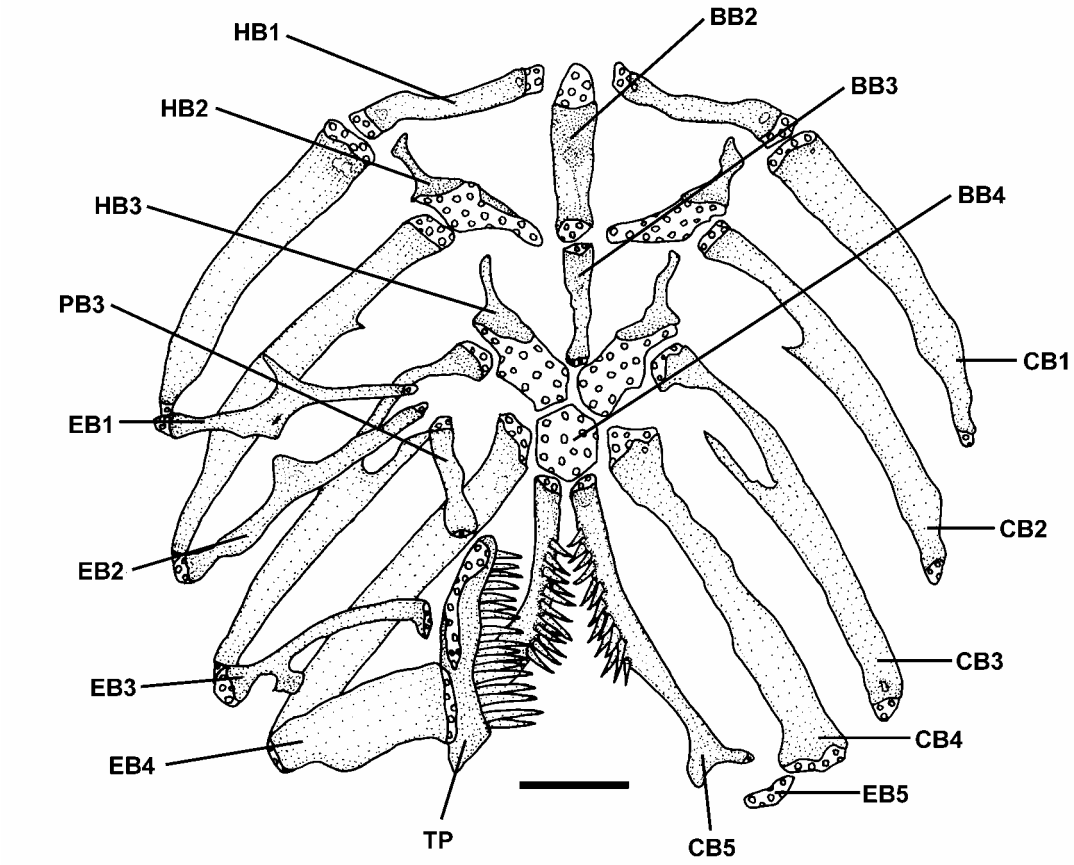

Fig. 25. Gill arches of *Trichomycterus* sp. C, paratype, MCP 22699 (79.0 mm SL), dorsal view, right dorsal elements and gill rakers not show. Abbreviations: BB2-4, basibranchials 2 to 4; CB1-5, ceratobranchials 1 to 5; EB1-5, epibranchials 1 to 5; HB1-3, hypobranchials 1 to 3; PB3, pharyngobranchial 3; TP; tooth plate. Scale bar = 1 mm.

Fig. 26. Ontogenetic variation in coloration present in five paratypes of *Trichomycterus* sp. C (UFRGS 14992, 40.5-92.5 mm SL).

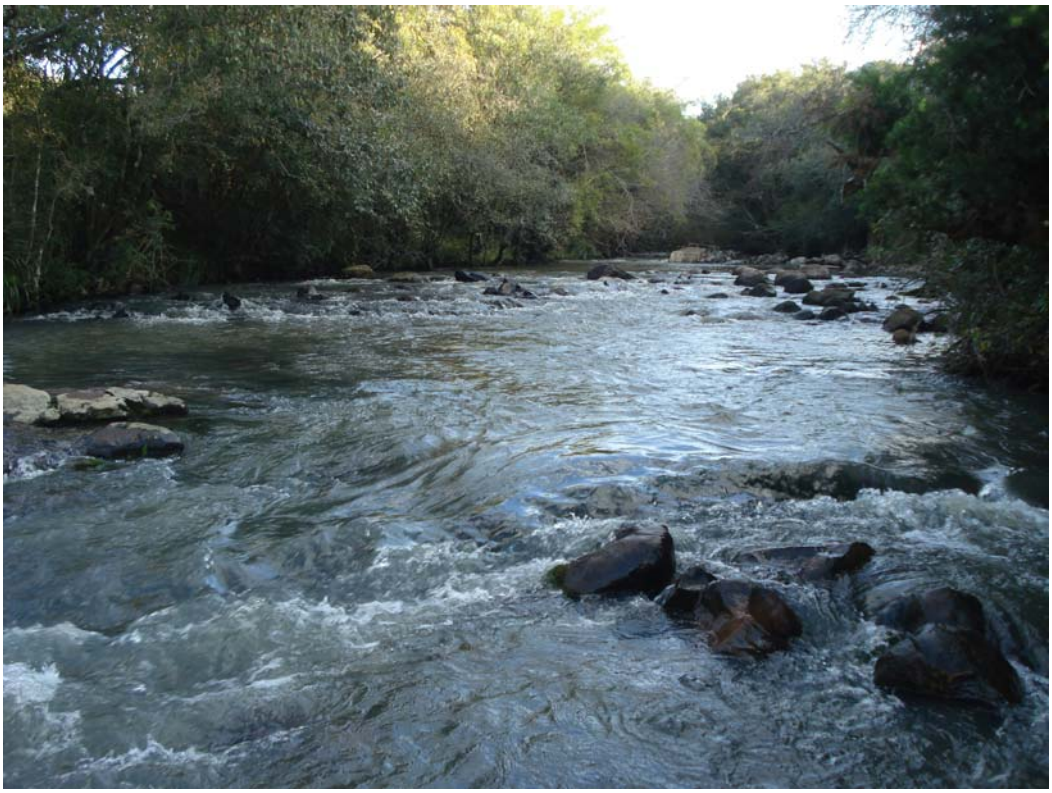

Fig. 27. Type locality of *Trichomycterus* sp. C: arroio Passo dos Buracos or Tipiaia on the road BR-158, Municipality of Júlio de Castilhos, State of Rio Grande do Sul, Brazil.

Fig. 28. *Trichomycterus* sp. D, holotype, MCN uncat., 61.1 mm SL, Brazil, State of Rio Grande do Sul, Municipality of Caraá, rio do Sinos.

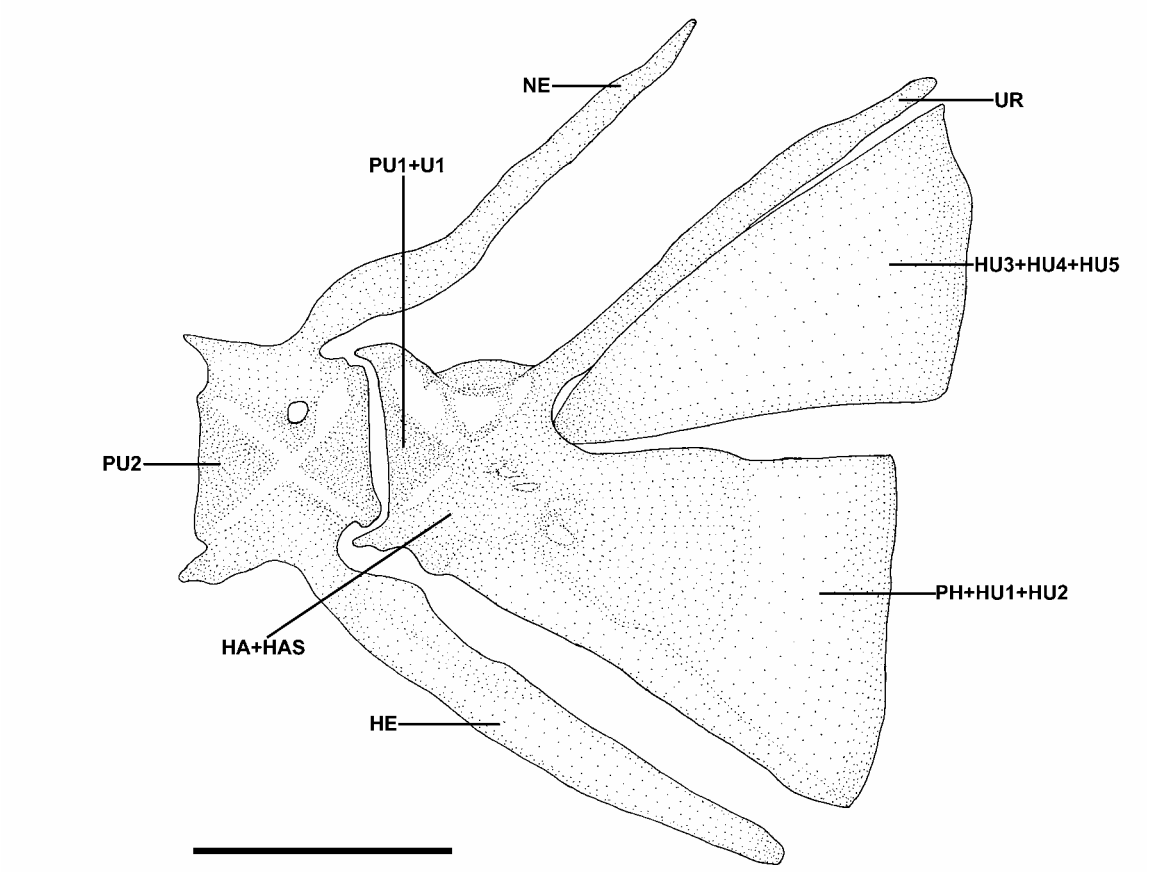

Fig. 29. Caudal skeleton of *Trichomycterus* sp. D, paratype, MCN uncat. (51.6 mm SL), lateral view. Abbreviations: HA+HAS, complex hypurapophysis composed of hypurapophysis and secondary hypurapophysis; HE, hemal spine; HU3+HU4+HU5, complex plate formed by co-ossification of hypurals 3 to 5; NE, neural spine; PH+HU1+HU2, complex plate formed by co-ossification of hypurals 1 and 2 and parhypural; PU1+U1, complex centrum composed of preural centrum 1 and ural centrum 1; PU2, preural centrum; UR, uroneural. Scale bar = 1 mm.

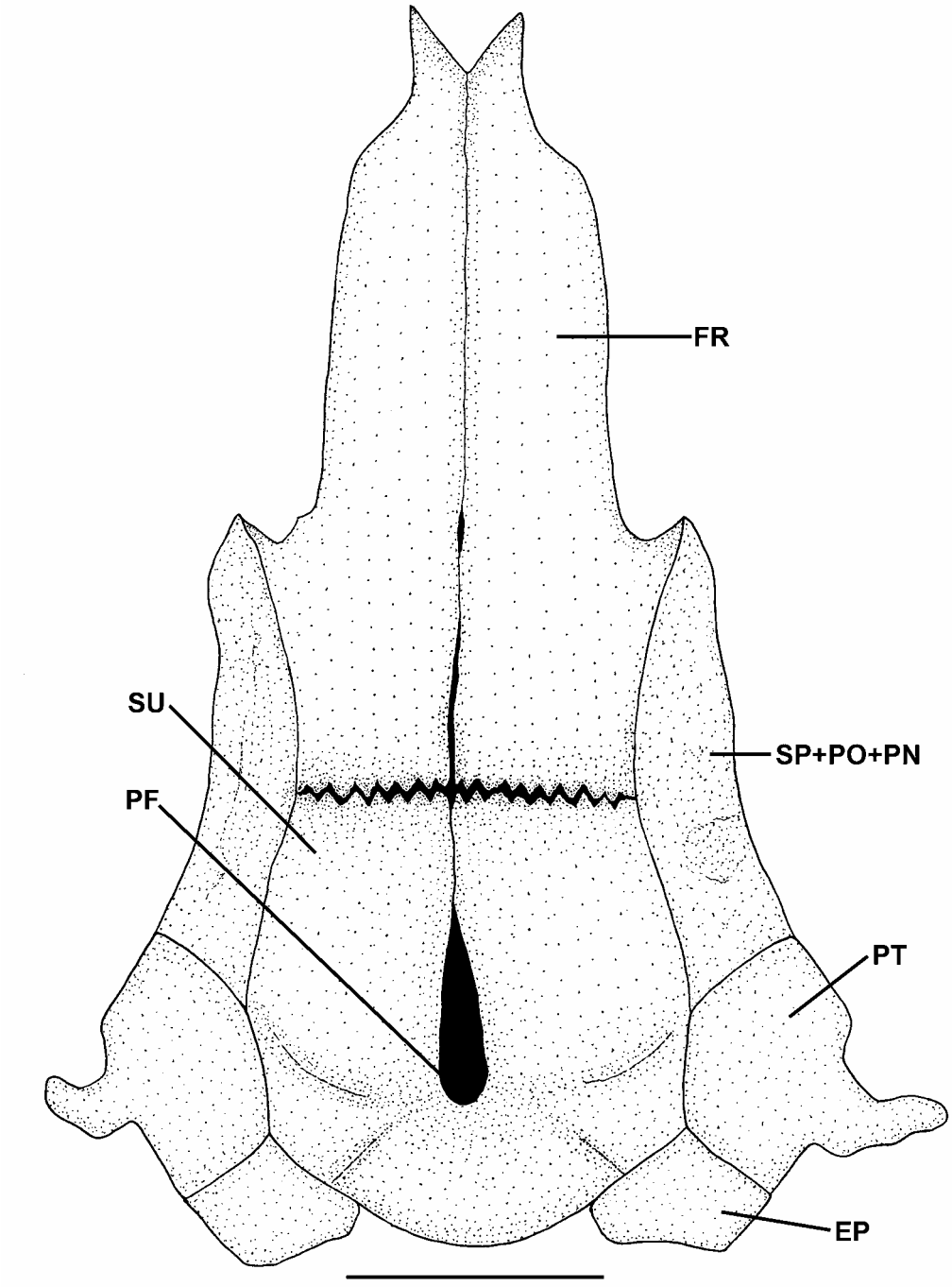

Fig. 30. Neurocranium of *Trichomycterus* sp. D, paratype, MCN uncat. (41.9 mm SL), dorsal view. Abbreviations: EP, epioccipital; FR, frontal; PF, posterior fontanel; PT, pterotic; SP+PO+PN, sphenotic-prootic-pterosphenotic complex bone; SU, parieto-supraoccipital. Scale bar = 1 mm.

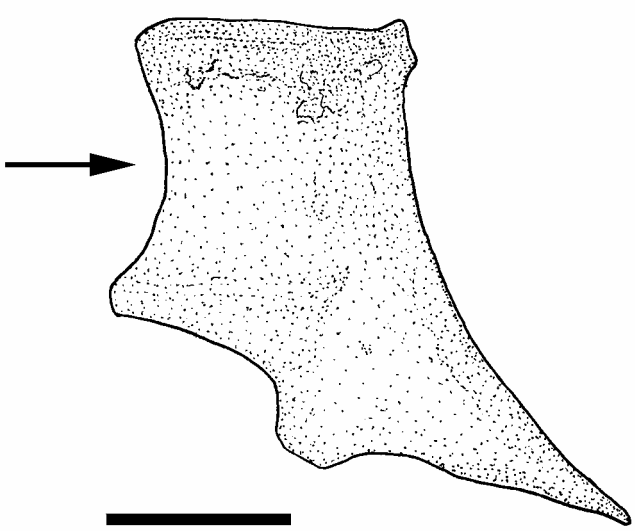

Fig. 31. Autopalatine of *Trichomycterus* sp. D, paratype, MCN uncat. (41.9 mm SL), dorsal view. Arrow indicates the concavity of mesial margin. Scale bar = 0.5 mm.

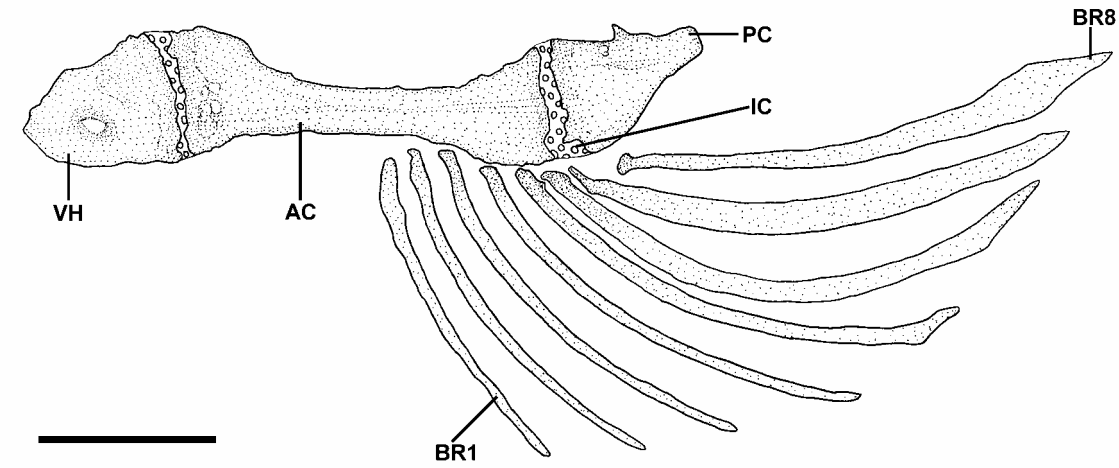

Fig. 32. Left hyoid arch of *Trichomycterus* sp. D, paratype, MCN uncat. (41.9 mm SL), lateral view. Abbreviations: AC, anterior ceratohyal; BR1-8, branchiostegal rays 1 to 8; IC, inter-ceratohyal cartilage; PC, posterior ceratohyal; VH, ventral hypohyal. Scale bar = 1 mm.

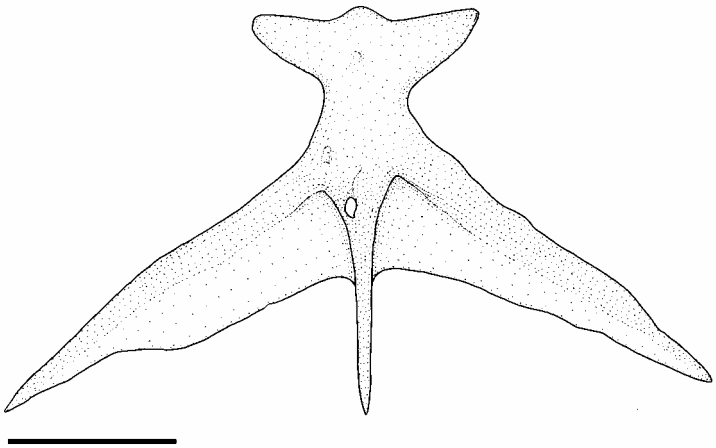

Fig. 33. Urohyal of *Trichomycterus* sp. D, paratype, MCN uncat. (41.9 mm SL), dorsal view. Scale bar = 0.5 mm.

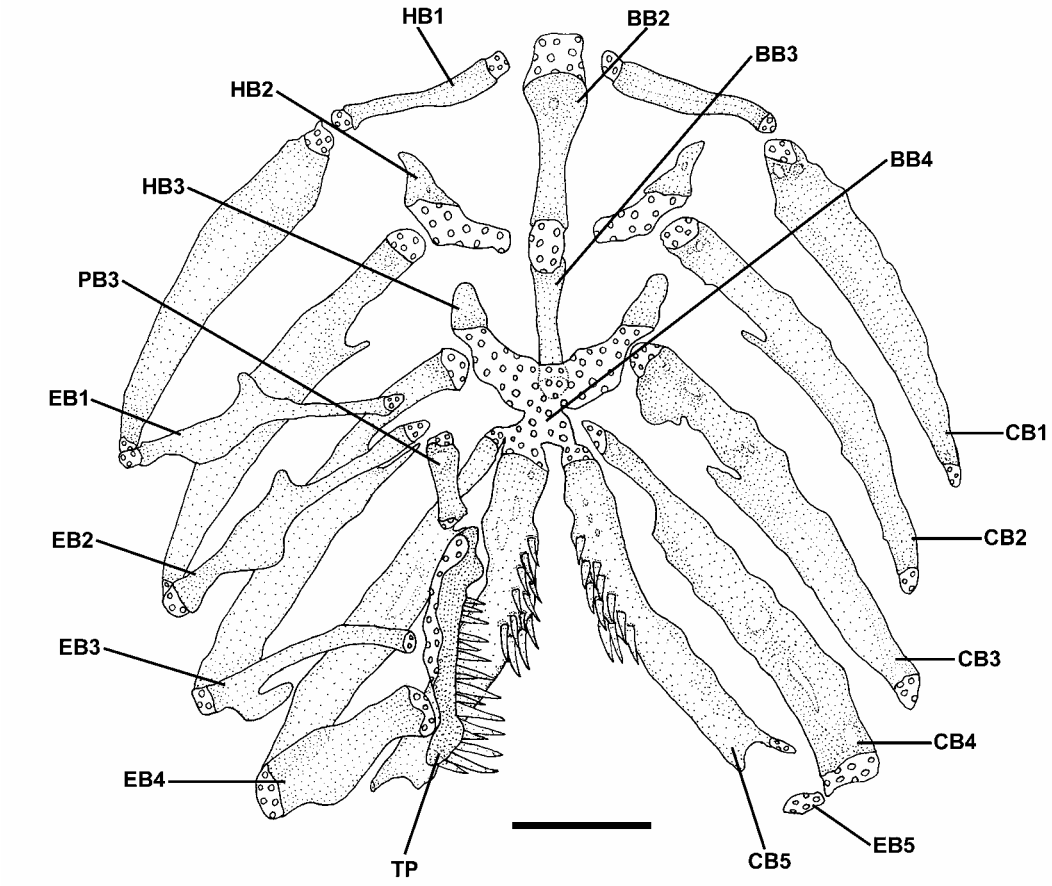

Fig. 34. Gill arches of *Trichomycterus* sp. D, paratype, MCN uncat. (51.6 mm SL), dorsal view, right dorsal elements and gill rakers not show. Abbreviations: BB2-4, basibranchials 2 to 4; CB1-5, ceratobranchials 1 to 5; EB1-5, epibranchials 1 to 5; HB1-3, hypobranchials 1 to 3; PB3, pharyngobranchial 3; TP; tooth plate. Scale bar = 1 mm.

Fig. 35. Locality where most types of *Trichomycterus* sp. D (11 specimens) were collected: rio do Sinos, Municipality of Caraá, State of Rio Grande do Sul, Brazil. Photo: R. B. Dala-Corte

Considerações finais

A revisão taxonômica do gênero *Trichomycterus* realizada no sistema da laguna dos Patos revelou a presença de cinco espécies novas: *Trichomycterus tropeiro*, que possui distribuição restrita, ocorrendo somente na porção mais superior do rio das Antas; *Trichomycterus* sp. n. A, que distribui-se na porção superior das bacias dos rios das Antas e Caí; *Trichomycterus* sp. n. B, endêmica da bacia do rio da Prata, tributário do rio das Antas; *Trichomycterus* sp. n. C, amplamente distribuída nos cursos superiores da bacia do rio Jacuí e tributários do rio Taquari-Antas; e *Trichomycterus* sp. n. D, endêmica do curso superior do rio do Sinos. As espécies de *Trichomycterus* presentes no sistema da laguna dos Patos distinguem-se de grande parte de seus congêneres do sul e sudeste do Brasil pelo baixo número de raios na nadadeira peitoral (I+5-6) e o primeiro raio da nadadeira peitoral não prolongado como filamento, exceto *T. davisi*, *T. mboycy*, *T. naipi*, *T. papilliferus*, *T. plumbeus* e *T. tropeiro*, distinguindo-se destas por outros caracteres.

Anexos

Anexo 1

Normas para publicação no periódico Zootaxa

Preparation of manuscripts

1) *General.* All papers must be in English. Authors whose native language is not English are encouraged to have their manuscripts read by a native English-speaking colleague before submission. Nomenclature must be in agreement with the *International Code of Zoological Nomenclature* (4th edition 1999), which came into force on 1 January 2000. Author(s) of species name must be provided when the scientific name of any animal species is first mentioned (the year of publication needs not be given; if you give it, then provide a full reference of this in the reference list). Authors of plant species names need not be given. Metric systems should be used. If possible, use the common font New Times Roman and use as little formatting as possible (use only **bold** and *italics* where necessary and indentions of paragraphs except the first). Special symbols (e.g. male or female sign) should be avoided because they are likely to be altered when files are read on different machines (Mac versus PC with different language systems). You can code them as m# and f#, which can be replaced during page setting. The style of each author is generally respected but they must follow the following general guidelines.

2) The **title** should be concise and informative. The higher taxa containing the taxa dealt with in the paper should be indicated in parentheses: e.g. A taxonomic revision of the genus *Aus* (Order: family).

3) The **name(s) of all authors** of the paper must be given and should be typed in the upper case (e.g. ADAM SMITH, BRIAN SMITH & CAROL SMITH). The address of each author should be given in *italics* each starting a separate line. E-mail address(es) should be provided if available.

4) The **abstract** should be concise and informative. Any new names or new combinations proposed in the paper should be mentioned. Abstracts in other languages may also be included in addition to English abstract. The abstract should be followed by a list of **key words** that are not present in the title. Abstract and key works are not needed in short correspondence.

5) The arrangement of the **main text** varies with different types of papers (a taxonomic revision, an analysis of characters and phylogeny, a catalogue etc.), but should usually start with an **introduction** and end with a list of **references**. References should be cited in the text as Smith (1999), Smith and Smith (2000) or Smith *et al.* 2001 (3 or more authors), or alternatively in a parenthesis (Smith 2000; Smith & Smith 2000; Smith *et al*. 2001). All literature cited in the text must be listed in the references in the following format (see a sample page here in PDF).

A) **Journal paper**:
Smith, A. (1999) Title of the paper. *Title of the journal in full*, volume number, page range.

B) **Book chapter**:
Smith, A. & Smith, B. (2000) Title of the Chapter. *In*: Smith, A, Smith, B. & Smith, C. (Eds), *Title of Book*. Publisher name and location, pp. x–y.

C) **Book**:
Smith, A., Smith, B. & Smith, C. (2001) *Title of Book*. Publisher name and location, xyz pp.

C) **Internet resources**
Author (2002) *Title of website, database or other resources*, Publisher name and location (if indicated), number of pages (if known). Available from: http://xxx.xxx.xxx/ (Date of access).

Dissertations resulting from graduate studies and non-serial proceedings of conferences/symposia are to be treated as books and cited as such. Papers not cited must not be listed in the references.

Please note that (1) **journal titles must be written in full (not abbreviated)**; (2) journal titles and volume numbers are followed by a ","; (3) page ranges are connected by "n dash", not hyphen "-", which

is used to connect two words. For websites, it is important to include the last date when you see that site, as it can be moved or deleted from that address in the future.

On the use of dashes: (1) Hyphens are used to link words such as personal names, some prefixes and compound adjectives (the last of which vary depending on the style manual in use). (2) En-dash or en-rule (the length of an 'n') is used to link spans. In the context of our journal that means numerals mainly, most frequently sizes, dates and page numbers (e.g. 1977–1981; figs 5–7) and also geographic or name associations (Murray–Darling River; a Federal–State agreement). (3) Em-dash or em-rule (the length of an 'm') are used far more infrequently, and are used for breaks in the text or subject, often used much as we used parentheses. In contrast to parentheses an em-dash can be used alone; e.g. What could these results mean—that Niel had discovered the meaning of life? En-dashes and em-dashes should not be spaced.

6) Legends of **illustrations** should be listed after the list of references. Small illustrations should be grouped into plates. When preparing illustrations, authors should bear in mind that the journal has a matter size of 25 cm by 17 cm and is printed on A4 paper. For species illustration, line drawings are preferred, although good quality B&W or colour photographs are also acceptable. See a guide here for detailed information on preparing plates for publication.

7) **Tables**, if any, should be given at the end of the manuscript. Please use the table function in your word processor to build tables so that the cells, rows and columns can remain aligned when font size and width of the table are changed. Please do not use Tab key or space bar to type tables.

8) **Keys** are not easy to typeset. In a typical dichotomous key, each lead of a couplet should be typed simply as a paragraph as in the box below:

1 Seven setae present on tarsus I ; four setae present on tibia I; leg I longer than the body; legs black in color ... Genus A
- Six setae present on tarsus I; three setae present on tibia I; leg I shorter than the body; legs brown in color ... 2
2 Leg II longer than leg I ... Genus B
- Leg II shorter than leg I ... Genus C

Anexo 2

Normas para publicação no periódico Neotropical Ichthyology

Manuscritos

- § Os manuscritos devem ser submetido em arquivos Word para Windows ou em arquivos rtf. Fotos devem ser submetidas em arquivos tif ou jpg separadamente.

Formato

- § Para artigos de sistemática consulte também: *Neotropical Ichthyology* taxonomic contribution style sheet
- § O texto deve ser submetido em Inglês.
- § O manuscrito deve conter, nesta ordem: Título, nome dos autores (*), endereço (não utilizar rodapé), palavras-chave (até cinco – não devem repetir palavras do título), Abstract, Resumo, Introdução, Material e Métodos, Resultados, Discussão, Agradecimentos, Referências Bibliográficas, Tabelas, Legendas das Figuras.
- § Manuscritos não devem exceder 60 páginas, incluindo Figuras e Tabelas. Exceções serão analisadas pelo Corpo Editorial.
- § Notas Científicas devem conter, nesta ordem: Título, nome dos autores (*), endereço (não utilizar rodapé), palavras-chave (até cinco – não devem repetir palavras do título), Abstract, Texto sem subtítulos, incluindo Introdução, Material e Métodos, Resultados e Discussão. Seguem Referências Bibliográficas, Tabelas, Legendas das Figuras. Notas Científicas somente serão aceitas caso contenham informações inéditas que justifiquem sua publicação imediata.

Texto

- § O texto não deve conter cabeçalho e rodapé (exceto número de página), ou qualquer formatação de parágrafo. Nunca use hífens para a separação de sílabas ao longo do texto. Nunca use a tecla "Tab" ou "espaço" para formatar referências bibliográficas. O texto deve estar alinhadas à esquerda, não justificado.
- § Nomes de espécies, gêneros, e termos em latim (*et al.*, *cf.*, *aff.*, *in vitro*, *in vivo*, etc.) devem ser apresentados em itálico. Não sublinhe nada no texto.
- § Somente os títulos das seguintes seções do manuscrito devem ser marcadas em Negrito: **Abstract**, **Introdução**, **Material e Métodos**, **Resultados**, **Discussão**, **Agradecimentos**, **Referências Bibliográficas**.
- § As abreviaturas utilizadas no texto devem ser referidas em Material e Métodos, exceto abreviaturas de termos de uso comum como min, km, mm, kg, m, Seg, h, ml, L, g.
- § Todas as medidas apresentadas devem empregar o sistema métrico.
- § Todos os artigos devem obrigatoriamente conter a indicação (número de catálogo e instituição depositária) de espécimes-testemunho ("voucher specimens") dos organismos estudados.
- § Agradecimentos devem ser concisos, com nome e sobrenome.
- § Figuras e Tabelas devem ser numeradas sequencialmente na ordem em que aparecem no texto, e citadas nos seguintes formatos: Fig. 1, Figs. 1-2, Fig. 1a, Figs. 1a-b, Tabela 1, Tabelas 1-2.
- § Nas legendas, as palavras **Tabela** e **Fig.** devem ser marcadas em negrito.
- § Legendas de Figuras devem ser apresentadas no final do manuscrito.
- § Tabelas devem ser construídas com linhas e colunas, não utilizando as teclas "Tab" ou "espaço". Tabelas não devem conter linhas verticais ou notas de rodapé. Arquivos digitais de Tabelas devem ser obrigatoriamente apresentados formatados em células. Arquivos digitais de Tabelas com colunas separadas por marcas de tabulação ou espaços vazios não serão aceitos.
- § As Tabelas e suas respectivas legendas devem ser apresentadas ao final do manuscrito, no seguinte formato: **Table 1.** Variação mensal do IGS médio em *Diapoma speculiferum* Cope....
- § Indicar ao longo do texto os locais sugeridos para inserção de Tabelas e Figuras.

Nomenclatura

- § Nomes científicos devem ser citados de acordo com o ICZN (2000).
- § Fornecer autoria no título e na primeira citação de cada nome científico de espécie ou gênero no texto em trabalhos taxonômicos. Não é necessário informar autoria no abstract.

Figuras

- § Figuras devem conter alta qualidade e definição para serem aceitas. Não submeta figuras impressas em dot-matrix.
- § Fotos digitais serão somente se apresentarem alta definição. Poderá ser solicitada uma cópia impressa de alto contraste e definição.
- § Textos contidos em gráficos ou figuras devem ter tamanho de fonte compatível com a redução para impressão na largura da página (175 mm) ou coluna (85 mm). Gráficos serão impressos preferencialmente em uma coluna (85 mm).
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Dissertações/Teses:

Langeani, F. 1996. Estudo filogenético e revisão taxonômica da família Hemiodontidae Boulenger, 1904 (*sensu* Roberts, 1974) (Ostariophysi, Characiformes). Unpublished Ph.D. Dissertation, Universidade de São Paulo, São Paulo. 171 p.

Artigo em revistas (listar nome do periódico por extenso):

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Type species.
Diagnosis. (see below the CONSIDERATIONS ON HOW TO PREPARE DIAGNOSES)
Etymology. (for new species only)
[**Remarks.]**
Key to species.
Comments on above:
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Diagnosis. (see below the CONSIDERATIONS ON HOW TO PREPARE SPECIES DIAGNOSES)
Description.
Coloration.
Size.
[**Sexual dimorphism.]**
Distribution.
[**Ecological notes**.]
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Specific issues:
Scientific names must always include the generic name, or at least an abbreviation for the generic name. This applies to tables and figure captions, as well as the text of the manuscript. Typically, the whole generic name should be spelled out in full at the first usage in each paragraph. Thereafter, an abbreviation can be used provided that there is no possibility of confusion with another generic name.
Bilaterally paired structures must be treated in the singular (e. g., pelvic fin short, not pelvic fins short)
Compound adjectives that include a noun should be connected by a hyphen (e. g., pectoral-fin spine, NOT pectoral fin spine).
Fin-ray formulae should be reported with unbranched rays in lower case Roman numerals, spines in upper case Roman, and branched rays in Arabic numerals. Transitions between different types of rays should be indicated by a comma (,) and not a plus sign (+), or dash (–) (e. g, iii,7 or II,9. Not iii–7 or iii+7; no spaces should be inserted after the comma). We treat the catfish spinelet as a spine, so dorsal fin counts that include a spinelet should be reported as II,6 (or whatever the branched ray count is).

Latitude and Longitude: No spaces between numerals and symbols. For degree sign, use Control +@, space (in MS Word) and not superscript O; for seconds, do not use the single quote mark twice, use the double quote mark (Shift quote).
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Revisions and reviews
Species accounts should be in alphabetical order.

CONSIDERATIONS ON HOW TO PREPARE SPECIES DIAGNOSES

A species diagnosis is typically a paragraph constructed of full sentences which list the most important traits that allow the reader to unequivocally identify the species. Ideally, the diagnosis includes one or more features that are unique to the species, preferably autapomorphic characters. If unique features were not discovered, the next best option is a differential diagnosis, within which a series of direct comparisons are made among species and the alternative character states specified by contrasts are stated explicitly (using "*vs.*" followed by the condition found in the species, or group of species, being compared, for each diagnostic feature). Diagnoses that consist only of a combination of characters (i.e., traits listed sequentially which, when considered together, distinguish the species from congeners) in many cases fail to make a convincing case that the species warrants recognition, mostly because too little information is offered in the way of direct comparisons with congeners. For that reason, this form of diagnosis should be avoided.