FERNANDA ELISA WEISS

SISTEMÁTICA E TAXONOMIA DE *HYPHESSOBRYCON LUETKENII* (BOULENGER, 1887) (CHARACIFORMES: CHARACIDAE)

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Sistemática e Taxonomia de *Hyphessobrycon luetkenii* (Boulenger, 1887) (Characiformes: Characidae)

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Aos meus pais, Nelson Weiss e Marli Gottems; minha irmã, Camila Weiss

e ao meu sobrinho amado, Leonardo Weiss Dutra.

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Resumo

Characidae é a maior e a mais diversificada família de Characiformes, entretanto, a maioria de seus agrupamentos internos, tanto a nível genérico como supragenérico, não pode ser diagnosticada como grupos monofiléticos. A situação é ainda mais problemática no que se refere aos gêneros com grande número de espécies, definidos por caráteres não informativos sob o ponto de vista filogenético. Entre os gêneros mais numerosos de Characidae estão *Hyphessobrycon* Durbin e *Astyanax* Baird & Girard. Uma das espécies mais problemáticas sob o ponto de vista filogenético é *Hyphessobrycon luetkenii* (Boulenger, 1887) cuja distribuição conhecida engloba drenagens do Rio Grande do Sul e Uruguai, rios costeiros do Rio de Janeiro e bacia do rio Paraguai; no entanto, as diferentes populações da espécie apresentam a linha lateral completa ou interrompida, caráter usualmente empregado na distinção entre os gêneros *Astyanax* e *Hyphessobrycon.* Uma análise filogenética para testar possíveis relações entre *Hyphessobrycon luetkenii* com algumas espécies de *Astyanax* de drenagens costeiras do leste do Brasil, e as espécies de *Deuterodon* Eigenmann, que compartilham alguns caráteres relacionados ao padrão de cor da mancha umeral e formato da dentição, é aqui realizada. A hipótese das relações filogenéticas de 240 táxons foi construída com base em 365 caráteres, analisados no software TNT utilizando o método de "pesos implícitos". As árvores obtidas com pesos implícitos com os valores de "k" de 21.9687 e 24.5965, foram mais estáveis do que as restantes, resultando numa árvore de consenso com 2702 passos (IC = 14; RI = 65). *Hyphessobrycon luetkenii* constitui um clado monofilético juntamente com *Astyanax giton* Eigenmann 1908, *A. hastatus* Myers 1928, *A. intermedius* Eigenmann 1908, *A. jenynsii* (Steindachner 1877), *A. parahybae* Eigenmann 1908, *A. ribeirae* Eigenmann 1911 e *A. taeniatus* (Jenyns 1842) denominado "clado *A. ribeirae*", que foi recuperado como grupo irmão do gênero *Deuterodon*, monofilético. *Hyphessobrycon luetkenii* é transferido para o gênero *Astyanax* que se conforma melhor ao conhecimento atual de suas relações. A espécie é diagnosticada pela presença de linha lateral incompleta ou interrompida com 9-18 escamas perfuradas, dentes na série interna do pré-maxilar com seis a sete cúspides, nadadeira anal com iii-v, 20-24 raios e pela presença de uma mancha umeral verticalmente alongada e relativamente arredondada com uma extensão estreita ventralmente, conferindo um formato geral de vírgula. Sua distribuição é restringida para o sistema dos laguna dos Patos, e bacias dos rio Uruguai, Negro, Paraguai, Tramandaí e Mampituba.

Abstract

Characidae is the largest and most diverse family of Characiformes; however, most of the generic and supra-generic groups cannot be diagnosed as monophyletic. The situation is more problematic in a genera with a large number of species, defined by uninformative characters under a phylogenetic framework. Among the more species rich genera are *Hyphessobrycon* Durbin and *Astyanax* Baird & Girard. One of the most problematic species under a phylogenetic standpoint is *Hyphessobrycon luetkenii* (Boulenger, 1887) whose distribution encompasses drainages of Rio Grande do Sul and rio Uruguay, coastal rivers of Rio de Janeiro and rio Paraguay basin; however, different populations of this species have the lateral line complete or interrupted, characters usually used to distinguish the genera *Astyanax* from *Hyphessobrycon*. A phylogenetic analysis to test possible relationships of *Hyphessobrycon luetkenii* with some species of *Astyanax* from coastal drainages of eastern Brazil and species of *Deuterodon* Eigenmann,(that share some characters similarities related to the color patterns of the humeral spot and analogous teeth shape), is performed herein. The hypothesis of relationships of 240 taxa was built based on 365 characters, analyzed in the TNT software using the method of "implied weights". The trees obtained under implied weights with "k" values of 21.9687 and 24.5965, which were more stable than the remaining ones, and summarized in a strict consensus tree with 2702 steps (CI = 14; RI = 65). *Hyphessobrycon luetkenii* constitutes a monophyletic clade along with *Astyanax giton* Eigenmann 1908, *A. hastatus* Myers 1928, *A. intermedius* Eigenmann 1908, *A. jenynsii* (Steindachner 1877), *A. parahybae* Eigenmann 1908, *A. ribeirae* Eigenmann 1911 and *A. taeniatus* (Jenyns 1842) herein denominated "*A. ribeirae* clade", that was recovered as a sister group of the monophyletic genus *Deuterodon*. *Hyphessobrycon luetkenii* is transferred to the genus *Astyanax*, which better conforms to the current knowledge about its relationships. The species is diagnosed by the presence of an incomplete or interrupted lateral line with 9-18 perforated scales, teeth in the inner row of premaxilla with six to seven cusps, anal-fin with iii-v, 20-24 rays with and the presence of a humeral spot vertically elongate and relatively rounded with a narrow extension ventrally, presenting a general shape of a comma, whose distribution is restricted to laguna dos Patos, rio Uruguay, rio Negro, rio Paraguay, rio Tramandaí and rio Mampituba drainages.

Apresentação

Os Characiformes constituem um dos maiores componentes da fauna de peixes de água doce, com cerca de 2.000 espécies reconhecidas em drenagens das regiões Neotropical e África (Nelson, 2006), com mais de 500 espécies de Characiformes descritas ao longo da última década, principalmente na região Neotropical (Eschmeyer & Fong, 2013).

Conforme classificações anteriores a Mirande (2009), os Characiformes eram constituidos de três famílias exclusivamente africanas (Citharinidae, Distichodontidae e Hepsetidae) (Géry, 1977; Calcagnotto *et al*., 2005), e 14 famílias neotropicais (Acestrorhynchidae, Anostomidae, Characidae, Chilodontidae, Crenuchidae, Curimatidae, Ctenoluciidae, Cynodontidae, Erythrinidae, Gasteropelecidae, Hemiodontidae, Lebiasinidae, Parodontidae, Prochilodontidae e Serrasalmidae (Reis *et al*., 2003; Calcagnotto *et al*., 2005), e uma família trans-Atlântico (Alestidae) (Zanata & Vari, 2005).

Characidae é a familia mais diversa e a mais problemática em ternos taxonômicos dentro desta ordem, com cerca de 1.100 espécies (representando aproximadamente 58% das espécies entre os Characiformes), e a quarta família mais diversa de peixes, após Cyprinidae, Cichlidae e Gobiidae (Eschmeyer & Fong, 2013). Os membros de Characidae ocorrem desde o sul dos Estados Unidos ao norte da Patagônia, na Argentina, sendo especialmente diversificado nas bacias hidrográficas da Amazônia, rios Orinoco e La Plata.

Muitas diagnoses de subfamílias e gêneros reconhecidos em Characidae baseiam-se nos trabalhos pré-cladísticos de Eigenmann (1912, 1915, 1917, 1918, 1921, 1927) e Eigenmann & Myers (1929). Eigenmann (1917), definiu 17 caráteres com diferentes estados, e utilizou-os em diferentes combinações para diagnosticar os gêneros em Characidae, considerando os estados mais freqüentes como sendo primitivo. Diante dessa metodologia, a composição e as relações de Characidae dentro dos Characiformes permanece instável.

No entanto, ao longo das últimas décadas, estudos sobre as relações entre táxons começaram a ser desenvolvidos e, desde então, muitos foram os autores que lidaram com a filogenia de alguns gêneros e subfamílias de Characidae (Machado-Allison, 1983; Weitzman & Fink, 1983; Weitzman & Fink, 1985; Reis, 1989; Malabarba, 1998a, 1998b; Weitzman & Menezes, 1998; Toledo-Piza, 2000; Vari & Harold, 2001; Malabarba & Weitzman, 2003; Weitzman *et al*., 2005; Menezes & Weitzman, 2009; Mirande, 2009, 2010, 2011; Thomaz *et* *al*., 2010; Mattox & Toledo-Piza, 2012; Tagliacollo *et al*., 2012; Weiss *et al*., 2012; Mariguela *et al*., 2013; Netto-Ferreira *et al*., 2013), além de estudos de filogenia e relações da família (Uj, 1990; Lucena, 1993; Ortí, 1997; Ortí & Meyer, 1997; Buckup, 1998; Calcagnotto *et al*., 2005; Mirande, 2009, 2010; Javonillo *et al*., 2010; Oliveira *et al*., 2011).

Em Reis *et al*. (2003), eram reconhecidas doze subfamílias de Characidae (Agoniatinae, Aphyocharacinae, Bryconinae, Characinae, Cheirodontinae, Clupeacharacinae, Glandulocaudinae, Iguanodectinae, Rhoadsiinae, Serrasalminae, Stethaprioninae e Tetragonopterinae), e de acordo com esta mesma publicação, 88 gêneros de Characidae (muitos dos quais monotípicos, e outros especiosos como *Astyanax* Baird & Girard, *Bryconamericus* Eigenmann, *Creagrutus* Günther, *Hemigrammus* Gill, *Hyphessobrycon* Durbin, *Jupiaba* Zanata e *Moenkhausia* Eigenmann, foram colocados como *incertae sedis* em Characidae por Lima *et al* (2003). Ainda no mesmo ano, Malabarba & Weitzman (2003) propuseram o reconhecimento de uma grupo monofilético dentro da família, denominado de Clado A, baseado em quatro sinapomorfias osteológicas: (i) presença de ganchos ósseos em diversas nadadeiras, (ii) ausência do osso supraorbital, (iii) posse de dois raios não ramificados e oito raios ramificados na nadadeira dorsal, e (iv) presença de quatro dentes na fileira interna do pré-maxilar. Este grupo incluiu muitos dos gêneros considerados *incertae sedis* na Characidae por Lima *et al*. (2003), juntamente com as subfamílias, Glandulocaudinae e Stevardiinae.(*sensu* Weitzman *et al*., 2005) Mais recentemente, trabalhos tanto morfológicos (Mirande, 2009, 2010), quanto moleculares (Javonillo *et al*., 2010; Oliveira *et al*., 2011), apesar de usarem um número variável de táxons e distribuicão, corroboraram a existência e relações do monofiletismo do Clado A de Malabarba & Weitzman (2003), entretanto, embora esses autores tenham utilizado novas ferramentas de análise em seus trabalhos, não encontraram suporte de monofilia para gêneros como: *Astyanax, Bryconamericus*, *Hemigrammus* e *Hyphessobrycon*.

Mirande (2009; 2010), baseado na filogenia com carateres morfológicos, propôs a monofilia para Characidae baseada em algumas sinapomorfias e rearranjou a grande parte dos gêneros listados em *incertae sedis* por Lima *et al*. (2003) em subfamílias (Acestrorhynchinae, Agoniatinae, Aphyocharacinae, Aphyoditeinae, Bryconinae, Characinae, Cheirodontinae, Cynodontinae, Gymnocharacinae, Heterocharacinae, Iguanodectinae, Rhoadsiinae, Salmininae, Stevardiinae, e Tetragonopterinae) e em clados (*Astyanax*, *Astyanax paris*, *Bramocharax*, *Bryconamericus scleroparius*, *Bryconops*, *Hyphessobrycon anisitsi*, *Hyphessobrycon luetkenii* e *Pseudochalceus*). As relações entre e dentro das espécies de

Hyphessobrycon é um bom exemplo de grupos problemáticos em Characidae. Weitzman & Palmer (1997) definiram tentativamente um grupo monofilético de *Hyphessobrycon* chamado "rosy tetras", incluindo uma pequena parte das espécies do gênero. Carvalho (2011), propôs uma hipótese de relações filogenéticas entre as espécies de *Hyphessobrycon*, reconhecendo o grupo dos "rosy tetras" (com algumas modificações conceituais de Weitzman & Palmer (1997)), como monofilético, incluindo também a espécie tipo do gênero, *Hyphessobrycon compressus* (Meek, 1904), e algumas espécies da América Central. Entre as espécies até então conhecido por *Hyphessobrycon*, *H. luetkenii* (Boulenger, 1887) não se encaixa no clado dos "rosy tetras" e representa um claro exemplo de como o uso da combinação de caracteres criados por Eigenmann para definir gêneros pode não representar monofilia entre os gêneros em Characidae. A distribuição desta espécie abrange a bacia da Laguna de Patos, bacias dos rios Uruguai, Tramandaí, Mampituba, Cubatão, Paraíba do Sul e Paraguai (Lima *et al*., 2003; López *et al*., 2003; Schifino *et al*., 2004; Abilhoa & Bastos, 2009; Malabarba *et al*., 2013), no entanto, as diferentes populações da espécie têm a linha lateral completa ou interrompida, caráter usualmente empregado para distinguir os gêneros *Astyanax* e *Hyphessobrycon.*

Algumas espécies de *Astyanax* ocorrem dentro da área de distribuição de *H. luetkenii*, como: *A. hastatus* Myers, 1928, *A. giton* Eigenmann, 1908 e *A. ribeirae* Eigenmann, 1911. Estas espécies apresentam algumas semelhanças com *H. luetkenii* no padrão da forma da mancha umeral e na forma e disposição dos dentes mandibulares, com os dentes diminuindo gradualmente em tamanho a partir da sínfise, caráter também utilizado no diagnóstico do gênero *Deuterodon* Eigenmann. Ao contrário de *Astyanax* e *Hyphessobrycon*, *Deuterodon* foi taxonomicamente revisado e seu monofiletismo proposto por Lucena & Lucena (1992, 2002). Sete espécies estão incluídas em *Deuterodon*: *D. iguape* Eigenmann, 1907, *D. longirostris* (Steindachner, 1907), *D. rosae* (Steindachner, 1908), *D. stigmaturus* (Gomes, 1947), *D. langei* Travassos, 1957, *D. singularis* Lucena & Lucena, 1992 e *D. supparis* Lucena & Lucena, 1992.

Embora estudos recentes tenham contribuído para uma melhor compreensão de Characidae, as relações entre as espécies acima discutidos permanecem obscuras. Javonillo *et al*. (2010) apresentaram uma hipótese filogenética para a Characidae utilizando sequências de DNA de três genes mitocondriais e de um gene nuclear, no entanto, essa análise não incluiu *H. luetkenii* ou qualquer outra espécies de *Astyanax* ou *Deuterodon* discutidas aqui. Mirande (2009, 2010) incluiu *H. luetkenii*, *D. iguape* e *D. langei* em suas análises. As espécies de *Deuterodon* em ambas as análises formaram um grupo monofilético, enquanto que *H.*

luetkenii foi agrupado ao clado *Astyanax* na hipótese de Mirande (2009), e em Mirande (2010) esta espécie forma um clado denominado "*H. luetkenii* clade", juntamente com *H. bifasciatus* Ellis 1911 e *A. latens* Mirande, Aguilera & Azpelicueta 2004. Mirande, no entanto, mais recentemente, reconheceu que o material de *H. luetkenii* utilizado nas suas análises não pertence a esta espécie, e assim, esta hipótese não deve ser tomada em conta (comun. pessoal). Em Oliveira *et al*. (2011), apenas *D. iguape* foi incluído no respectivo estudo. Travassos (1957) comentou sobre a semelhança entre *A. hastatus* e *Deuterodon*, e Lucena & Lucena (1992), também indicaram semelhanças entre *A. hastatus*. e *D. stigmaturus* quanto as cúspides de dentes da série interna do pré-maxilar e dentário. Mais tarde, Lucena & Lucena (2002) também encontraram similaridade em caráteres da dentição e mancha umeral presente nas espécies de *Deuterodon* com *A. giton, A. hastatus* e *H. luetkenii*.

O principal objetivo deste trabalho é o estudo dos caráteres compartilhados entre *Hyphessobrycon luetkenii*, *Deuterodon* spp., e algumas espécies de *Astyanax* das drenagens costeiras do leste do Brasil, cujo significado filogenético é avaliado em uma análise mais abrangente.

A presente tese está estruturada em formato de artigo científico, e os dois capítulos estão apresentados sob forma de artigo, formatados de acordo com as normas da revista *Neotropical Ichthyology*, para a qual serão submetidos. O Capítulo 1 corresponde à análise filogenética de *Hyphessobrycon luetkenii* com algumas espécies de *Astyanax* de drenagens costeiras do leste do Brasil, e as espécies de *Deuterodon*, que compartilham alguns caráteres relacionados ao padrão de cor da mancha umeral e formato dos dentes. O grupo é reconhecida como monofilético, e modificações taxonômicas são realizadas visando uma melhor compreensão das relações entre os táxons. No Capítulo 2, *Hyphessobrycon luetkenii* é redescrito com base no material tipo e especimens oriundos do sistema hidrográfico da laguna dos Patos, e sua distribuição é discutida.

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CAPÍTULO 1

Systematics of *Hyphessobrycon luetkenii* (Boulenger, 1887) (Characiformes: Characidae)

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Abstract

A phylogenetic analysis to test possible relationships between *Hyphessobrycon luetkenii* and some species of *Astyanax* from coastal drainages of eastern Brazil and member of *Deuterodon*, that share some characters related to the shape of the humeral spot and tooth shape, is performed herein. The hypothesis of phylogenetic relationships of 240 taxa was built based on 365 characters, analysed in the TNT software using the method of "implied weights". The trees obtained resulted in "k" values of 21.9687 and 24.5965, which were more stable than the remaining ones, and they are summarized in a strict consensus tree with 2702 steps (CI = 14; RI = 65). In this analysis, *Hyphessobrycon luetkenii* forms a monophyletic clade along with *Astyanax giton*, *A. hastatus*, *A. intermedius*, *A. jenynsii*, *A. parahybae, A. ribeirae* and *A. taeniatus* denominated "*A. ribeirae* clade", which was recovered as a sister group to the monophyletic genus *Deuterodon*. *Hyphessobrycon luetkenii* is transferred to the genus *Astyanax* that better conforms to the current knowledge about it's relationships.

Resumo

Uma análise filogenética para testar possíveis relações entre *Hyphessobrycon luetkenii* com algumas espécies de *Astyanax* de drenagens costeiras do leste do Brasil, e as espécies de *Deuterodon*, que compartilham alguns caracteres relacionados ao padrão de cor da mancha umeral e forma do dente, é aqui realizada. A hipótese das relações filogenéticas de 240 táxons foi construído com base em 365 caráteres, analisados no software TNT utilizando o método de “pesos implícitos”. As árvores obtidas com pesos implícitos com os valores de “k” 21.9687 and 24.5965, foram os mais estáveis do que os restantes, resultando numa árvore de consenso com 2702 passos (IC = 14; RI = 65). *Hyphessobrycon luetkenii* constitui um clado monofilético juntamente com *Astyanax giton*, *A. hastatus*, *A. intermedius*, *A. jenynsii*, *A. parahybae*, *A. ribeirae* e *A. taeniatus* denominado “*A. ribeirae* clado”, que foi reconhecido como grupo irmão do gênero monofilético *Deuterodon*. *Hyphessobrycon luetkenii* é transferido para o gênero *Astyanax*, conforme o atual estado de conhecimento das relações com as outras espécies.

Key words: Neotropical, Characiforms, Fish, Cladistics, Implied weight.

Introduction

The family Characidae is one of the most diverse family of fishes, and the most diverse in the Neotropics, with more than 1040 species distributed from the southern United States to the northern Patagonia in Argentina (Eschmeyer & Fong, 2013). The majority of the characid genera was defined based in different combinations of 17 characteristics with discrete alternative states, described by Eigenmann (1917). The most frequent states were considered primitive by Eigenmann (1917), but not in the cladistic sense. The studies done in the last few decades revealed developing relationships among the taxa, Since then, many authors have dealt with the phylogeny of some genera and subfamilies of Characidae (Machado-Allison, 1983; Weitzman & Fink, 1985; Reis, 1989; Malabarba, 1998a, 1998b; Weitzman & Menezes, 1998; Toledo-Piza, 2000; Vari & Harold, 2001; Malabarba & Weitzman, 2003; Zanata & Toledo-Piza, 2004; Weitzman *et al*., 2005; Menezes & Weitzman, 2009; Thomaz *et al*., 2010; Mirande, 2011; Malabarba *et al*., 2012; Mariguela *et al*., 2012; Mattox & Toledo-Piza, 2012; Tagliacollo *et al*., 2012; Weiss *et al*., 2012; Netto-Ferreira *et al*., 2013). There have also been studies of the phylogeny and relationships of the family (Uj, 1990; Lucena, 1993; Ortí, 1997; Ortí & Meyer, 1997; Buckup, 1998; Calcagnotto *et al*., 2005; Mirande, 2009, 2010; Javonillo *et al*., 2010; Oliveira *et al*., 2011).

Mirande (2009) proposed the monophyly and a classification of the Characidae based on a phylogenetic analysis focusing on analytical issues. Mirande (2010) proposed a monophyletic definition of Characidae based on the following nine synapomorphies: 1.

Orbitosphenoid slender, relatively small and separate from parasphenoid; 2. Rhinosphenoid present; 3. Canal of lateral line on caudal-fin membrane present; 4. Total number of vertebrae (41 or more); 5. Number of branched anal-fin rays (25 or more); 6. Anterior ventral procurrent caudal-fin rays fused in laminar medial bones; 7. *Radii* of scales not converging at focus; 8. Attachment of medial tendon of A1 section of *adductor mandibulae* on quadrate near its articulation with preopercle and 9. *Radii* oriented towards anterior field of scales absent. Besides the redefinition of family, the following subfamilies and clades were recognized: Acestrorhynchinae, Agoniatinae, Aphyocharacinae, Aphyoditeinae, Bryconinae, Characinae, Cheirodontinae, Cynodontinae, Gymnocharacinae, Heterocharacinae, Iguanodectinae, Rhoadsiinae, Salmininae, Stevardiinae, and Tetragonopterinae; *Astyanax* clade, *Astyanax paris* clade, *Bramocharax* clade, *Bryconamericus scleroparius* clade, *Bryconops* clade, *Hyphessobrycon luetkenii* clade, and *Pseudochalceus* clade. Although many subfamilies of Characidae show well supported phylogenetic hypotheses, there are many genera and clades that still require studies to investigate their relationships.

The relationships among and within *Hyphessobrycon* Durbin species is a prime example of the problematic groups in Characidae. Weitzman & Palmer (1997) tentatively defined a monophyletic *Hyphessobrycon* named “rosy tetras clade”, including a small portion of the species within the genus. Carvalho (2011) proposed a hypothesis of phylogenetic relationships among the species of *Hyphessobrycon*, recognizing the group of the “rosy tetras” (with some modifications from Weitzman & Palmer’s concept) as monophyletic, also including the type species of the genus, *Hyphessobrycon compressus* (Meek, 1904), and some species from Central America.

Among the species known to *Hyphessobrycon*, *H. luetkenii* (Boulenger, 1887) does not fit in the “rosy tetras” clade and represents a strong example of how the use of the combination of characters created by Eigenmann to define the genera may cause non-monophyly in the Characidae genera. The distribution of this species encompasses the laguna do Patos, rio Uruguay, rio Tramandaí basin, rio Mampituba, rio Cubatão, rio Paraiba do Sul in Rio de Janeiro State, rio Paraná and rio Paraguay basins (Lima *et al*., 2003; López *et al*., 2003; Schifino *et al*., 2004; Abilhoa & Bastos, 2009; Malabarba *et al*., 2013), however, the different populations of the species have the lateral line complete or interrupted, a character commonly used to distinguish the genera *Astyanax* Baird & Girard and *Hyphessobrycon*. Since the species has been described from the laguna dos Patos drainage population, it has been recognized as *Hyphessobrycon* by the interrupted lateral line, instead of *Astyanax*.

Some species of *Astyanax* occur within the distribution area of *H. luetkenii*, such as *A. hastatus* Myers, 1928 and *A. giton* Eigenmann, 1908 and *A. ribeirae* Eigenmann, 1911. These species present similarities with *H. luetkenii* in the shape of the humeral spot and in the shape and arrangement of the dentary teeth, with their teeth decreasing gradually in size from the symphysis, a character also used in the diagnosis of the genus *Deuterodon* Eigenmann. Unlike *Astyanax* and *Hyphessobrycon*, *Deuterodon* has been taxonomically revised and its monophyletism proposed by Lucena & Lucena (1992, 2002, 2013). Seven species are included in *Deuterodon*: *D. iguape* Eigenmann, 1907, *D. longirostris* (Steindachner, 1907), *D. rosae* (Steindachner, 1908), *D. stigmaturus* (Gomes, 1947), *D. langei* Travassos, 1957, *D. singularis* Lucena & Lucena, 1992 and *Deuterodon supparis* Lucena & Lucena, 1992.

Although recent studies have contributed to a better understanding of Characidae, the relationships between the species discussed above remain unclear. Javonillo *et al*. (2010) presented an advanced phylogenetic hypothesis for the Characidae using DNA sequences of three mitochondrial genes and one nuclear gene; however they did not include *H. luetkenii* or any of the species of *Astyanax* or *Deuterodon* discussed above in the analysis. Mirande (2009, 2010) included *H. luetkenii*, *D. iguape* and *D. langei* in his analysis, and *H. luetkenii* was recovered as belonging to the *Astyanax* clade in the hypothesis of Mirande (2009), while in Mirande (2010) this species forms a clade denominated "*H. luetkenii* clade" along with *H. bifasciatus* Ellis 1911 and *A. latens* Mirande, Aguilera & Azpelicueta 2004. Mirande (pers.comun.). However, it was later found that his material of *H. luetkenii* was misidentified and does not belong to this species; therefore, this hypothesis must be not taken into account.

The *Deuterodon* species in both analysis were found to form a monophyletic group. Oliveira *et al*. (2011) used a broad taxon sampling and a large molecular dataset with sequence data from two mitochondrial and three nuclear genes to find the relationships amongst Characiforms. Their results corroborate with the molecular phylogeny of Javonillo *et al*. (2010) using sequences of some different genes, but only *D. iguape* was included in this study.

Travassos (1957) commented on the similarity between *A. hastatus* and *D. pedri* Eigenmann 1908, and Lucena & Lucena (1992) also found similarities between the cusps of the inner series of premaxilla and dentary teeth in both *A. hastatus* and *D. stigmaturus*. Later, Lucena & Lucena (2002) also remarked a similarity in characteristics of the dentition and humeral spot present in the species of *Deuterodon* with *A. giton, A. hastatus* and *H. luetkenii.*

The main purpose of this work is to study the characteristics shared between *Hyphessobrycon luetkenii*, the species of *Deuterodon*, and some species of *Astyanax* treated herein, whose phylogenetic significance must be assessed in a more comprehensive analysis.

Material and Methods

Taxon sampling. A total of 240 taxa were included in the analysis (Appendix I). The selection of taxa followed Mirande (2010) and Carvalho (2011), including 160 taxa from Mirande (2010) in addition to 67 taxa and modifications of character status from Carvalho (2011). We added herein 13 taxa: *Astyanax giton*, *A. hastatus* (Fig. 1), *A. intermedius* (Eigenmann, 1908), *A. janeiroensis* (Fig. 2), *A. jenynsii* (Steindachner, 1877) (Fig. 3), *A. parahybae* (Eigenmann, 1908) (Fig. 4), *A. ribeirae*, *A. taeniatus* (Jenyns, 1842), *D. longirostris*, *D. rosae*, *D. singularis*, *D. stigmaturus*, *D. supparis*. Three taxa: *D. iguape*, *D. langei* and *H.luetkenii* were analyzed in both previous analysis. Data from *H. luetkenii* from the analyses of Mirande (2009, 2010); however, were not considered, since his material does not correspond to this species. Specimens were cleared and stained (c&s) following Taylor & van Dyke (1985). Myological nomenclature follows Winterbottom (1974). Osteological nomenclature follows Weitzman (1962), with modifications from Zanata & Vari (2005).

Institutional abbreviations. Material from the following institutions were analyzed:

ANSP - Academy of Natural Sciences of Philadelphia, Philadelphia, USA; BMNH - British Museum of Natural History, London, UK; CAS - California Academy of Sciences, San Francisco, USA; DZSJRP - Departamento de Zoologia e Botânica, Universidade Estadual Paulista, São José do Rio Preto, Brazil; MCP - Museu de Ciências e Tecnologia da Pontíficia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; MCZ - Museum of Comparative Zoology, Cambridge, USA; MZUSP - Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil; UFRGS - Departamento de Zoologia da Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; USNM - National Museum of Natural History, Smithsonian Institution, Washington D.C., USA. In the list of material examined, the catalog number is followed by the number of specimens counted and measured and length range of the specimens in the lot.

Cladistic methodology. In order to investigate the relationships of *H. luetkenii* and other species tested in this analysis, the methods of equal weighted parsimony analysis and implied weighted parsimony analysis were employed using the TNT software version 1.1 (Goloboff, Farris & Nixon, 2008), based on the Hennig's (1966) and subsequent authors' concepts of parsimony. Weighting methods have been used in analyzes, usually with problematic groups, where equal weighted parsimony analysis results in hypotheses with low resolution, generally caused by the presence of highly homoplasic characters (Goloboff, 1993; Mirande, 2009, 2010). However, the idea behind the weighting methods is to strengthen the evolutionary information from characters with higher congruence with other characters, and with the phylogenetic hypothesis itself. Consequently, characters with low congruence with the phylogenetic hypothesis have their weight decreased, inversely proportional to their number of homoplastic steps (Goloboff, 1993; Mirande, 2009, 2010). The weighted analysis under the implied weights (IW) method herein performed followed Goloboff (1993) and Mirande (2009). The IW is a character weighting method, where characters are downweighted as a function of the number of homoplasic steps they have, surveyed during the tree search. One of the possible advantages of this method is that it distinguishes the extra steps of a very homoplasic character from the extra steps of a less homoplasic character through weighting, while in a simple parsimony analysis all characters receive equal weights, regardless of how well or how poorly they fit into a given tree. The characters are downweighted based on a constant "k", which had been chosen arbitrarily by Mirande (2009), who proposed the methodology for "k"-values search, which is herein adopted. In this method, the "k"- values used in the IW were calculated in the derived formula of character fit [F = k / (S + k)] in the function of "k" [k = (FS) / (1 – F)], from the distribution of the fit/distortion (F) values in regular intervals associated to the "average" number of homoplasic steps (S). The "average" number of homoplasic steps [(number of steps - minimum number of steps) / minimum number of steps] is calculated from the total number of steps and the minimum number of steps, obtained from the mostparsimonious trees under equal weights. The "k"-values herein used were those assign to an "average" character to fit the values of 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, and 90% of the fit of a perfectly hierarchic character. IW analyses for each "k"-value was performed and the strict tree consensus for each saved. The reliability of these 21 tree consensuses was assessed through their stability inferred by SPR distances (Goloboff, 2008) (Table 1), known as the number of branch moves necessary to change one tree into another, calculated in the TNT software. Finally, the most stable tree will be the less parameter-dependent, which needs a lower number of changes to turn into any other tree once it shares a higher number of nodes with the remaining trees. In the case of more than one tree presenting the same SPR distance value, the strict consensus of them has been used. The methods of new technology described in Nixon (1999) and Goloboff (1999) available in the TNT were applied in both weighted and unweighted analyzes. The parsimony ratchet, combined with the methods of tree-fusing, sectorial search, and tree-drifting, using the default parameters presented by the software. All characters were treated as unordered and given the same *a priori* weight. The distribution of ambiguous character states was examined according to the ACCTRAN optimization, maximizing reversals to parallelisms, as discussed by de Pinna (1991). The character polarity was only determined after the simultaneous analysis of global parsimony including all ingroup and outgroup taxa, and rooting in *Puntius tetrazona*, following Nixon & Carpenter (1993).

The Bremer (1994) methodology is herein used to calculate the branch support for the most parsimonious trees, and was calculated in the TNT software. The analysis was configured to retain trees suboptimally by 12 steps, generated by TBR (tree bisection and reconnection) from the trees obtained from equal weighted parsimony in the strict tree consensus. For the "implied weighted" analysis, the Bremer support values were calculated from the "k"-values of strict tree consensus. The search was done with the purpose of finding the suboptimal trees using the following commands "sub 0:01; hold 1000; fillonly = bb" with variations "sub" ranging 0.01, increasing gradually the trees in memory (*i.e.*, sub 0:01; hold 1000; fillonly = bb) (sub 0:02; hold 2000, bb = fillonly), successively until all clades losing their stabilities (represented by "?" on the branches of analysis), except at the root. The matrix of data was generated and edited in the software Mesquite version 2.6 (Maddison & Maddison, 2010) and in WinClada version 1.0 (Nixon, 1999-2002). Polymorphic conditions were filled out with a "&" between the character state codes (e.g. 0&1), inapplicable character states were represented by "-" and missing entries by "?" when the character state could not be observed due to structural damage of the material, lack of appropriate analysis, or missing data from the literature and polymorphisms by a "z".

Results and Discussion

Phylogenetic diagnoses for clades and terminal taxa. The parsimony analysis under equal weights of 240 species codified for 365 morphological characters resulted in 3 equally parsimonious trees possessing 2664 steps, with a consistency index (CI) of 14 and a retention index (RI) of 66. Those hypotheses are summarized in a strict tree consensus with 2682 steps (CI = 14; RI = 65) (Fig. 5).

The IW trees obtained from “k”-values 21.9687 and 24.5965 were found to be more stable than the trees possessing other “k”-values, resulting in a total of 972 trees. The strict consensus from those IW trees has 2702 steps (CI = 14; RI = 65) (Fig. 6). The data concerning all the IW trees obtained from different “k”-values and the SPR values among them are shown in the Table 1. Both parsimony analyses, with implied weights and equal weights, recovered the monophyly of the clade including *H. lutekenii*, *A. ribeirae*, *A. hastatus*, *A. giton*, *A. intermedius*, *A. taeniatus*, *A. jenynsii*, *A. parahybae* and *Deuterodon* species; however, the IW analysis showed a better resolution (Fig. 7) and it is the phylogenetic hypothesis in which the discussion is focused and all the synapomorphies and characters indices (ci and ri) are taken from.

The list of characters including number of steps, ci and ri for each character are given in the Appendix II. The number of the clades was given by the TNT software (Fig. 6) and the synapomorphies for each clade are summarized in the Appendix III. The transitions and total number of steps for each character are shown in the Appendix IV. The Bremer support values are presented in the base of the clades in the Fig. 4 for the equal weighted parsimony analysis, and in the Fig. 5 for the IW analysis based on the trees obtained under the “k”- 24.5965. The following list of synapomorphies, reversals, and independent acquirements will be restricted to the clade containing *H. luetkenii*.

Probolodus heterostomus*, *D. longirostris*, *D. singularis*, *D. stigmaturus*, *D. rosae*, *D. iguape*, *D. langei*, *H. lutekenii*, *A. ribeirae*, *A. hastatus*, *A. giton*, *A. intermedius*, *A. taeniatus*, *A. jenynsii*, *A. parahybae*, *E. uruguayensis*, *C. jaguaribensis*, *H. parana*, *M.* sp. n, *M. dichroura*, *M.* cf. *intermedia*, *B. steindachneri*, *M. xinguensis*, *H. moniliger*, *J. polylepis*, *J. mucronata*, *J. scologaster*, *H. pulchripinnis*, *H. socolofi*, *H. takasei*, *C. troemneri* and *C.* aff. *troemneri

(Node 368)

1. Dorsal-fin bony hooks in adult males of species bearing hooks on fins [Char. 311: 0 > 1]. Uniquely derived.

2. Caudal-fin bony hooks in adult males of species bearing hooks on fins [Char. 312: 0 > 1]. Uniquely derived.

Probolodus was described as a new monotypic genus of Aphyocharacinae to coastal basins of southeastern Brazil by Eigenmann (1911), characterized by a peculiar dentition in jaws: "Premaxilary with three teeth somewhat directed outward, each with three points in the angles of a nearly isosceles triangle, the middle point, which is also the anterior one, much heavier, maxillary with three to five teeth; each ramus of the mandible with four large teeth, the first three directed outward, the fourth, and one or more smaller ones following it, directed upward; the larger teeth of the lower jaw heavy, conical, with a minute cusp on each side." Eigenmann, also considered the new species very similar in general appearance with *A. fasciatus* (Cuvier, 1819).

Aphyocharacinae proposed by Eigenmann (1909), included *Cheirodon* Girard and other five genera that share a single series of teeth in the premaxilla: *Holoshesthes* Eigenmann (now synonym of *Odontostilbe* Cope *in* Malabarba, 1998a), *Odontostilbe*, *Coelurichthys* Miranda-Ribeiro (Synonym of *Mimagoniates* Regan by Weitzman & Fink, 1985), *Aphyocharax* Gunther and *Holoprion* Eigenmann (Synonym of *Aphyocharax in* Reis *et al*., 2003). In 1915 Eigenmann proposed the name Cheirodontinae to replace Aphyocharacinae, expanding the subfamily to 21 genera and 56 species. Géry (1960) defined three tribes among Cheirodontinae and included more genera in the subfamily. *Probolodus* was included in Aphyocharacidi tribe, the most heterogene of the new tribes. Géry (1972) recognized the Cheirodontinae as a subfamily apart from Aphyocharacinae and new taxonomic changes regarding the Cheirodontinae tribes were compiled in Géry (1977), where a Probolodini tribe was proposed, including genus *Probolodus* based on the presence of few tricuspid, everted teeth of premaxilla. Malabarba (1998) proposed a new diagnosis for Cheirodontinae and *Probolodus* was considered not related to the Cheirodontinae and listed as an *incetae sedis* characid genus. Mirande (2009) included *Probolodus* in his analysis of the family Characidae, the genus was included in the "*Hemigrammus* clade" among the other *incertae sedis* genera in Characidae (*Bario* Myers, *Deuterodon*, *Hasemania* Ellis, *Hemigrammus* Gill, *Hyphessobrycon*, *Moenkhausia* Eigenmann, *Myxiops* Zanata, *Paracheirodon* Géry, *Petitella* Géry, *Pristella* Eigenmann and *Thayeria* Eigenmann). In Mirande (2010), *Probolodus* was related in a monophyletic assemblage named of Tetragonopterinae. This clade included *Bario*, *Brachychalcinus* Boulenger, *Deuterodon*, *Gymnocorymbus*, *Hasemania*, *Hemigrammus*, *Hyphessobrycon*, *Jupiaba* Zanata, *Moenkhausia*, *Myxiops*, *Paracheirodon*, *Orthospinus* Reis, *Petitella*, *Poptella* Eigenmann, *Pristella*, *Stethaprion* Cope, *Stichonodon* Eigenmann, *Tetragonopterus* Cuvier, and *Thayeria*, This clade includes the type-species of the highly diverse genera *Hemigrammus* and *Moenkhausia*.

Both equal weighting and implied weighting analyses recovered *Probolodus* forming a clade along with *Deuterodon*, *H. luetkenii*, *A. ribeirae* and other *Astyanax* species of southeastern Brazil (*A. hastatus*, *A. giton*, *A. intermedius*, *A. taeniatus*, *A. jenynsii*, *A. parahybae*), and *Ectrepopterus uruguayensis* clade. The basal position of *P. heterostomus* in this clade is weakly supported by two only synapomorphies, whose status is marked as unknown in the *Deuterodon* and missing in some *Astyanax* (*A. giton*, *A. jenynsii* and *A. parahybae*): the presence of bony hooks in the dorsal fin (Ch. 311:1) and in the caudal fin (Ch. 312:1) of adult males. The presence of hooks on the anal- and pelvic-fin rays is found in most genera and subfamilies of Characidae (Azpelicueta & Garcia, 2000; Malabarba & Weitzman, 2003; Mirande, 2010) and usually represent a secondary sexual characters of males; however, the presence of small bony hooks in the dorsal and cauda- fin rays is found in a smaller number of taxa.

The analyse presents herein, *P. heterostomus* clade corroborates with Mirande's analysis (2009, 2010) about relationships with *Deuterodon*, *Jupiaba* and *Moenkhausia* species; although, it is found to not be related with *Tetragonopterus argenteus* Cuvier, 1816 (Tetragonopterinae). These results were corroborated with subsequent work of Carvalho (2011), Jerep (2011) and Oliveira *et al*. (2011), which related *Probolodus* within other *incertae sedis* species in Characidae clades, in with specious and polyphyletic genera.

Autapomorphies of *Probolodus heterostomus*

1. Fourth infraorbital longer dorsoventrally than longitudinally [Char. 67: 0 > 1]. Independently acquired in Node 394, *Astyanax intermedius* and *Hyphessobrycon socolofi* Weitzman, 1977. Polymorphic in *Bario steindachneri* (Eigenmann, 1893). Missing in *Astyanax janeiroensis*.

2. Presence of mamilliform teeth outside the mouth [Char. 120: 0 > 1]. Uniquely derived.

3. One premaxillary row of teeth [Char. 122: 1 > 0]. Independently acquired in Node 415. Polymorphic in *Ectrepopterus uruguayensis* (Fowler, 1943).

4. Four or less teeth in the inner premaxillary row [Char. 129: 1 > 0]. Uniquely derived.

5. Ventral end of posttemporal posterior to epioccipital [Char. 253: 0 > 1]. Independently acquired in Node 455. Polymorphic in *Hyphessobrycon moniliger* Moreira, Lima & Costa, 2002.

6. Twenty-five or more branched anal-fin rays [Char. 288: 0 > 1]. Independently acquired in Node 417. Polymorphic in *Cheirodon troemneri* (Fowler, 1942), *Ectrepopterus uruguayensis*, *Hyphessobrycon moniliger*, *Hyphessobrycon pulchripinnis* Ahl, 1937, *Jupiaba mucronata* (Eigenmann, 1909), *Jupiaba polylepis* (Günther, 1864), *Moenkhausia* sp. n and *Moenkhausia dichroura* (Kner, 1858).

7. Two pairs of Uroneurals [Char. 306: 0 > 1]. Independently acquired in Node 362. Polymorphic in *Cheirodon* aff. t*roemneri* and *Moenkhausia* cf. *intermedia* Eigenmann, 1908.

Deuterodon longirostris, D. singularis, D. stigmaturus, D. rosae, D. iguape, D. langei, H. lutekenii, A. ribeirae, A. hastatus, A. giton, A. intermedius, A. taeniatus, A. jenynsii, A. parahybae, E. uruguayensis, C. jaguaribensis, H. parana, M.* sp. n*, M. dichroura, M.* cf. *intermedia, B. steindachneri, M. xinguensis, H. moniliger, J. polylepis, J. mucronata, J. scologaster, H. pulchripinnis, H. socolofi, H. takasei, C. troemneri* and *C.* aff. *troemneri

(Node 367)

1. Pectoral-fin bony hooks in adult males of species bearing hooks on fins [Char. 310: 0 > 1]. Reversal in *Astyanax giton.*

Deuterodon. longirostris, D. singularis, D. stigmaturus, D. rosae, D. iguape, D. langei, H. lutekenii, A. ribeirae, A. hastatus, A. giton, A. intermedius, A. taeniatus, A. jenynsii* and *A. parahybae

(Node 452)

1. Distance between cartilage anterior to orbitosphenoid and lateral ethmoids contacting, or almost contacting lateral ethmoids [Char. 38: 1 > 0]. Independently acquired in Node 362, Node 393 and *Hemigrammus parana* Marinho, Carvalho, Langeani & Tatsumi, 2008. Polymorphic in *Hyphessobrycon luetkenii*.

2. Presence of branching of laterosensory canals of fourth or fifth infraorbitals [Char. 74: 0 > 1]. Polymorphic in *Astyanax ribeirae*, *Deuterodon iguape*, *Hyphessobrycon pulchripinnis*, *Moenkhausia xinguensis* (Steindachner, 1882), *Probolodus heterostomus*.

3. Presence of canal of lateral line on caudal-fin membrane [Char. 92: 0 > 1]. Independently acquired in Node 393. Ambiguous in Node 362.

4. Five or more cusps of teeth on the outer premaxillary row [Char. 125: 0 > 1]. Independently acquired in *Jupiaba scologaster* (Weitzman & Vari, 1986). Reversal in *Astyanax giton*.

5. Five or more cusps of anterior maxillary teeth [Char. 139: 0 > 1]. Independently acquired in Node 393, *Cheirodon* aff. t*roemneri* and *Hyphessobrycon pulchripinnis*. Polymorphic in *Moenkhausia xinguensis*, *Bario steindachneri*. Ambiguous in Node 452.

This clade represents the species that share the following common characters: teeth of the inner row of premaxilla and maxilla flattened and multicuspidate; dentary teeth gradually decreasing; one humeral spot conspicuous, vertically elongate with superior portion wider and with an inferior narrow extension, giving a “comma shape” (except *A. jenynsii* and *A. parahybae*), with distribution in the coastal drainages of South and Southeast of Brazil. This clade corroborates with previous studies (Travassos 1957; Lucena & Lucena 1992, 2002; Melo 2001) regarding the possible relationships between species with similar dentary teeth pattern. Although these taxa are closely related, the character about dentary teeth [Char. 148: 1], is highly homoplastic (23 steps) and shows a low consistency index (ci = 4) which, according to the present analysis, is not influencing the support of this clade.

Monophyly of *Deuterodon*

(Node 451)

1. Margins of toothed region of maxilla dorsally divergent Char. 96: 0 > 1]. Uniquely derived.

2. Four or more maxillary teeth: [Char. 136: 0 > 1]. Independently acquired in *Ectrepopterus uruguayensis* and *Hyphessobrycon socolofi*. Reversal in *Deuterodon singularis.* Polymorphic in Node 392, *Hyphessobrycon moniliger*, *Jupiaba scologaster*, *Moenkhausia* sp. n and *Probolodus heterostomus*.

3. Absence of bony hooks on fins: [Char. 307: 1 > 0]. Independently acquired in Node 365. Reversal in *Bario steindachneri*, *Cheirodon* aff. *troemneri* and *Hyphessobrycon socolofi*.

The genus *Deuterodon* was described by Eigenmann in Eigenmann, McAtee & Ward (1907) from a specimen collected in municipality of Iguape (coastal system in southeastern Brazil). The genus was characterized by the presence of two rows of teeth on the premaxilla, teeth multicuspid expanded distally, and dentary teeth decreasing gradually in size (Eigenmann, 1927).

The relationships among the Characidae family proposed by Lucena (1993) established a great basal polytomy among *D. iguape* and 18 other genera of Characidae. Lucena & Lucena (2002) proposed a new definition for the genus based on three synapomorphies related to the jaws with only seven species being recognized as valid: *D. iguape*, *D. longirostris*, *D. rosae*, *D. stigmaturus*, *D. langei*, *D. singularis*, and *D. supparis.* Among the synapomorphies for the genus, the following were defined: the ventral margin of the toothed portion of the jaw diverging from the dorsal margin anteriorly, ventral margin of the jaw with teeth arching toward the ventral margin of the premaxilla in order to form a continuous axis, and posterior region of the edentulous maxillary short length, which is, at most, twice the length of the region of teeth of this bone. Furthermore, *Deuterodon* is recognized for other characters widely distributed among the Characidae, such as two rows of teeth on the premaxilla, the inner row with five teeth and the outer row with 1-3 teeth,(6-7 cusps on the teeth of the inner row of the premaxilla). maxilla and dentary (3-7 maxillary teeth, dentary teeth decreasing gradually), the lateral lip more atrophied in most species, absence of scales on the fins, and lateral line complete (Lucena & Lucena, 1992, 2002).

Mirande (2009, 2010) included only two *Deuterodon* species (*D. iguape* and *D. langei*), and one of the three synapormophies presented by Lucena & Lucena (2002) on analysis of the Characidae family under Implied Weighting methodology. Both species showed a close relationship and were included in a revalidated clade Tetragonopterinae together with the following genera: *Bario*, *Brachychalcinus* Boulenger, *Gymnocorymbus*, *Hasemania*, *Hemigrammus*, *Hyphessobrycon*, *Jupiaba*, *Moenkhausia*, *Myxiops*, *Paracheirodon*, *Orthospinus*, *Petitella*, *Poptella*, *Pristella*, *Probolodus*, *Stethaprion*, *Stichonodon*, *Tetragonopterus*, and *Thayeria.*

Pereira (2010) hypothesized relationships between *Deuterodon* species, beyond the seven species of *Deuterodon sensu* Lucena & Lucena (2002). Pereira included *D. parahybae* Eigenmann, 1908 and *D. pedri*; two other species *incertae sedis* in Characidae by Reis *et al*. (2003). The results showed that *Deuterodon* is a monophyletic unit including *D. parahybae* and *D. pedri* based on one uniquely derived characteristic of the presence of 33 vertebrae.

About the interrelationships among the species, Lucena & Lucena (2002) suggested that *D. langei*, *D. rosae* and *D. stigmaturus* are closely related by sharing a longer divergent margin of tooth region of maxilar and by a shorter length of posterior edentulous of maxilla. Both characteres were not measured in this analysis. These results, under implied weighing, pointed out a closer relation among *D. longisrostris*, *D. singularis* and *D. stigmaturus* in a clade and *D. iguape*, *D. langei* and D. *rosae* in another clade, and *D. supparis* having the most basal species of the *Deuterodon* clade. Pereira (2010) recognized a monophyletic clade without implied weighting methodology, (*D. longirostris*, *D. supparis* (*D. iguape* (*D. langei* (*D. stigmaturus* (*D. rosae*, *D. singularis*))))). In our analysis, using parcimony with equal weighs, shows a monophyletic *Deuterodon* clade (*D. singularis* (*D. stigmaturus* (*D. longirostris* (*D. supparis* (*D. rosae* (*D. iguape*, *D. langei*)))))).

The main goal of this current work is to study phylogenetic significance among the taxa that shared some characters related in dentition and color pattern. The significance phylogenetic of interrelationships among the *Deuterodon* species will not be discussed.

Autapomorphies of *Deuterodon supparis*

1. Laterosensory canal of sixth infraorbital branched [Char. 76: 0 > 1]. Polymorphic in *Cheirodon* aff. *troemneri*.

2. Anterior end of ascending process of maxilla with a conspicuous notch [Char. 94: 1 > 0]. Independently acquired in *Deuterodon stigmaturus*.

3. Posterior extension of ventral process of quadrate reaching vertical through posterior margin of symplectic [Char. 151: 1 > 0]. Independently acquired in Node 361 and Node 393. Ambiguous in Node 456 and *Astyanax giton.*

Monophyly of *D. longirostris*, *D. singularis*, *D. stigmaturus*, *D. rosae*, *D. iguape* and *D. langei*

(Node 450)

1. Expansion of lamellar much pronounced of portion of maxilla just posterior to toothed region [Char. 97: 0 > 1]. Polymorphic in *Cheirodon troemneri* and *Deuterodon iguape*.

Monophyly of *D. longirostris*, *D. singularis* and *D. stigmaturus*

(Node 453)

1. Laterosensory canal of first infraorbital absent or not projected dorsally [Char. 73: 0 > 1]. Independently acquired in Node 458 and *Ectrepopterus uruguayensis*. Ambiguous in Node 398.

Deuterodon longirostris

No autapomorphies

Monophyly of *D. singularis* and *D. stigmaturus*

(Node 454)

1. Two (adnates) dorsal-fin rays on last pterygiophore: [Char. 272: 0 > 1]. Independently acquired in Node 457 and *Astyanax janeiroensis*.

Autapomorphies of *Deuterodon singularis*

1. Tubules for passage of blood vessels on lamellar portion of maxilla with an anterior branch, parallel to anterior margin of maxilla, reaching one third of its length [Char. 98: 0 > 1]. Independently acquired in *Astyanax intermedius* and *Deuterodon rosae*. Polymorphic in *Deuterodon longirostris*.

2. Presence of interdigitations between premaxillae [Char. 103: 1 > 0]. Reversal.

3. Presence of interdigitations between premaxillae [Char. 136: 1 > 0]. Ambiguous in Node 392. Reversal in Node 451, *Cheirodon stenodon* Eigenmann, 1915, *Ectrepopterus* *uruguayensis* and *Hyphessobrycon socolofi*. Polymorphic in *Probolodus heterostomus* *Moenkhausia* sp. n and *Hyphessobrycon moniliger*.

4. Two well developed blocks of cartilage anterior to basihyal [Char. 188: 0 > 1]. Independently acquired in *Jupiaba scologaster*. Ambiguous in Node 363, Node 457, *Astyanax intermedius* and *Hyphessobrycon luetkenii*. Polymorphic in *Hyphessobrycon moniliger* and *Hyphessobrycon socolofi*.

5. Posterior margin of cleithrum without a concavity ventral to first postcleithrum [Char. 234: 1 > 0]. Independently acquired in Node 393, Node 415, Node 456, *Ectrepopterus uruguayensis* and *Hyphessobrycon socolofi*. Reversal in *Astyanax taeniatus*. Polymorphic in *Hyphessobrycon luetkenii*. Ambiguous in Node 448and Node 361.

Autapomorphies of *Deuterodon stigmaturus*

1. Anterior end of ascending process of maxilla with a conspicuous notch [Char. 94: 1 > 0]. Independently acquired in *Deuterodon supparis*.

2. Presence of a lateral ridge of anguloarticular [Char. 107: 0 > 1]. Uniquely derived.

Monophyly of *D. rosae*, *D. iguape* and *D. langei*

(Node 449)

1. Absence of contact between ectopterygoid and anterodorsal region of quadrate [Char. 162: 0 > 1]. Polymorphic in *Deuterodon iguape* and *Jupiaba scologaster*.

Autapomorphies of *Deuterodon rosae*

1. Presence of contact between frontals anteriorly to frontal fontanel [Char. 21: 0 > 1]. Independently acquired in *Astyanax giton* and *Bario steindachneri*. Polymorphic in *Cheirodon jaguaribensis* (Fowler, 1941), *Deuterodon iguape* and *Moenkhausia* sp. n. Ambiguous in Node 417 and *Hyphessobrycon socolofi*.

2. Tubules for passage of blood vessels on lamellar portion of maxilla with an anterior branch, parallel to anterior margin of maxilla, reaching one third of its length [Char. 98: 0 > 1].

Independently acquired in *Astyanax intermedius* and *Deuterodon singularis*. Polymorphic in *Deuterodon longirostris*.

3. Presence of a longitudinal ridge in quadrate bordering *adductor mandibulae* muscle ventrally and, to some degree laterally [Char. 152: 0 > 1]. Independently acquired in Node 457.

Monophyly of *D. iguape and D. langei*

(Node 448)

1. Absence of foramen on articular condyle of quadrate [Char. 149: 1 > 0]. Ambiguous in Node 452, Node 458 and *Astyanax giton*.

2. Two dorsal-fin rays articulated with first dorsal pterygiophore [Char. 266: 1 > 0]. Independently acquired in *Bario steindachneri*. Ambiguous in Node 455 .Polymorphic in *Cheirodon jaguaribensis*, *Cheirodon troemneri*, *Hyphessobrycon moniliger* and *Moenkhausia* cf. *intermedia*.

Deuterodon iguape

No autapomorphies

Autapomorphies of *Deuterodon langei*

1. Supraoccipital spine projected dorsal to, at least, middle length of neural complex of Weberian apparatus [Char. 53: 1 > 0]. Ambiguous in Node 361, Node 414, Node 452, Node 456 and Node 458. Reversal i n *Astyanax janeiroensis*.

2. Presence of an articulation between ventral margin of metapterygoid and posterodorsal margin of quadrate [Char. 155: 0 > 1]. Uniquely derived.

Hyphessobrycon lutekenii, A. ribeirae, A. hastatus, A. giton, A. intermedius, A. taeniatus, A. jenynsii* and *A. parahybae

(Node 457)

1. Presence of longitudinal ridge in quadrate bordering *adductor mandibulae* muscle ventrally and, to some degree laterally [Char. 152: 0 > 1]. Independently acquired in *Deuterodon rosae*.

2. Two (adnates) Number of dorsal-fin rays on last pterygiophore: [Char. 272: 0 > 1]. Independently acquired in Node 454 and *Astyanax janeiroensis*.

Hyphessobrycon luetkenii* and *A. ribeirae

(Node 458)

1. Laterosensory canal of first infraorbital absent or not projected dorsally [Char. 73: 0> 1]. Independently acquired in Node 453 and *Ectrepopterus uruguayensis*. Ambiguous in Node 398.

2. Form and articulation of neural pedicle of third vertebra well developed pedicle, articulating synchondrally with neural complex [Char. 218: 1 > 0]. Uniquely derived.

Carvalho (2011) tested the monophyly of the "rosy tetra" *Hyphessobrycon* group, adding more characters and taxa in Mirande's phylogeny (2009, 2010), and, as a result, *Hyphessobrycon* "rosy tetra" was found to be a monophyletic group limited to 24 species in Characidae based on the following non-ambigous synapomorphy: posistion of Weberian apparatus upward horizontal through dorsal margin of operculum. *Hyphessobrycon luetkenii* was not included is his *Hyphessobrycon* monophlyletic clade, but is found within *Bario*, *Deuterodon*, *Ectrepopterus*, *Gymnocorymbus*, *Hyphessobrycon* (*lato sensu*), *Jupiaba*, *Moenkhausia*, *Poptella*, *Probolodus, Stethaprion, Stichonodon* and *Tetragonopterus*, which is similar to the Tetragonopterinae clade of Mirande (2010). In this current analysis, *H. luetkenii* and *A. ribeirae* formed a clade closely related to *Astyanax* from the Leste system of Brazil.

The description of *Astyanax ribeirae* by Eigenmann (1911) was based on material collected along the coastal rivers in the state of Paraná and São Paulo. Oyakawa *et al*. (2006) considered this species endemic to the basin of the Ribeira Valley; however, Oliveira (2011) recorded the occurrence of *A. ribeirae* in the basin of Ribeira Valley and the Atlantic basin of Paraná State, corroborating Eigenmann (1911). More recently, the same author confirmed the presence of this species in the Araranguá basin, in Santa Catarina State (personal information).

Hyphessobrycon luetkenii and *A. ribeirae* share a similar pattern of humeral spot form and denitition of dentary with *A. giton, A. hastatus* and *A. taeniatus,* although, these species were allocated in two different genera. According to the classical systematics of the family (Eigenmann, 1917), *Hyphessobrycon* only differs from *Astyanax* by having an interrupted lateral line. Malabarba (1998a) commented that the most probable common character used by Eigenmann to recognize various Characid genera is the completeness of the lateral line. In his analysis, the inclusion of the lateral line as complete or interrupted in the analysis was responsible for a reduction of the consistency index and increased the shortest tree length. He concluded that even in small lineage of Characidae, lateral line completeness is shown to be highly homoplastic and poorly informative to species relationships.

Autapomorphies of *Hyphessobrycon luetkenii*

1. Lateral line interrupted [Char. 91: 0 > 1]. Reversal in Node 363 and Node 393.

Astyanax ribeirae

No autapomorphies

Astyanax hastatus, A. giton, A. intermedius, A. taeniatus, A. jenynsii* and *A. parahybae

(Node 456)

1. Absence of Anterior paired projections of parasphenoid [Char. 40: 1 > 0]. Independently acquired in *Cheirodon jaguaribensis*. Polymorphic in *Hyphessobrycon pulchripinnis*, *Hyphessobrycon socolofi*, *Moenkahusia* cf. *intermedia*. Ambiguous in Node 392.

2. Posterior margin of cleithrum without a concavity ventral to first postcleithrum [Char. 234: 1 > 0]. Independently acquired in Node 393 and Node 415, *Ectrepopterus uruguayensis*, *Deuterodon singularis* and *Hyphessobrycon socolofi*. Reversal in *Astyanax taeniatus*. Polimorphic in *Hyphessobrycon luetkenii.* Ambiguous in Node 361 and Node 448.

3. Position of ventral end of posttemporal anterior to lateral margin of epioccipital [Char. 252: 1 > 0]. Independently acquired in *Moenkhausia* cf. *intermedia*. Polymorphic in *Cheirodon* aff. *troemneri.*

The genus *Astyanax* is a speciose group of Neotropical characid fishes comprising of more than 130 valid species (Eschmeyer & Fong, 2013), occurring in freshwater drainages from southern United States to central Argentina. The nominal species currently assigned to *Astyanax* probably do not represent a monophyletic entity. *Astyanax* was revised by Eigenmann (1921, 1927), whose accounts still constitute the sole, all-inclusive review of the genus. The current definition of *Astyanax* is based on a combination of characters proposed by Eigenmann (1917) which are. however, widespread among genera in the Characidae, *i.e*. two rows of premaxillary teeth, five teeth in the inner premaxilla series, lateral line complete, adipose fin present, and caudal fin naked. Over the years, many researchers tentatively proposed complexes of species in an attempt to recognize sub monophyletic groups within the genus based on a set of molecular and morphological characters. Moreira-Filho & Bertollo (1991) were the first to characterize *A. scabripinnis* (Jenyns, 1842) as a "species complex" consisting of at least six populations diagnosed on the basis of morphological and kariotypic characters and occurring in the upper rio Paraná and the rio São Francisco basin. Bertaco & Malabarba (2001) expanded the discussion of the complex with their description of two new species in the complex that, according to those authors, share very low anal-fin ray counts and are morphologically similar to the subspecies described within *A. scabripinnis*. Garutti (1995) presented a review of the species of *Astyanax* with humeral oval spot and oddly colored yellow fins. As the main result, Garutti recognized several species within what was traditionally identified as *A. bimaculatus* (Linnaeus, 1758). Melo (2005) proposed a *A. fasciatus* "species complex" based on the definition of *A. fasciatus* by Eigenmann (1921) developed on the form of the vertically elongated humeral spot.

Although, in the past few years, many *Astyanax* species have been described, but the knowledge of their relationships remains unclear. According to Mirande (2009, 2010), the *Astyanax* species analyzed constitute a clade composed of the genera *Astyanax* (*A. mexicanus*), *Markiana* Eigenmann, and *Psellogrammus* Eigenmann, in addition to some species currently classified in the genus *Hyphessobrycon.* However, given the relatively low taxon sampling and some variations between different searches, little progress has been made about the relatioships among species of this genus.

The reason for adding the *Astyanax* species in this analysis was based on the similarity in the pattern of dentition with dentary teeth decreasing gradually and the general morphology in relation to *H. luetkenii*. *A. giton*, *A. hastatus* and *A. taeniatus* were later included in the analysis. The remaining species of *Astyanax*, showing a different dentition pattern (dentary teeth decreasing abruptly from the synphisis), were analyzed together because they most likely represent endemic species related to the formation of southeast coastal basins; although, some of the species were allocated in a different species complex for a genus.

The analysis of *Astyanax* species from southeast coastal basins resulted in a polytomy under both optimizations used in the analysis. This polytomy can be explained in part by the low number of characters coded in the matrix. The characters of *A. hastatus*, *A. parahybae*, *A. jenynsii* and *A. janeiroensis* plotted in this analyses were created using data from type material examined (*A. parahybae*; *A. janeiroensis, A. hastatus* and *A. jenynsii)* since the recognition of the species is not totally clear and many data, measurements, and counts show a large overlap.

Although, the present analysis does not represent a clear explanation about the relationship among the species, this result infers a close relation between the species of southeast coastal basin (except *A. janeiroensis*).

The relations among these species need to be evaluated in futher morphological and molecular analyzes. Melo (2001) revised the *Astyanax* species distributed in Serra dos Órgãos in Rio de Janeiro State, including the most part of species presented here; however, some species were not examined as well as the phylogenetic hypothesis had proposed.

Astyanax giton*, *A. intermedius*, *A. taeniatus*, *A. jenynsii* and *A. parahybae

(Node 455)

1. Abrupt decrease in size of dentary teeth present [Char. 148: 0 > 1]. Independently acquired in *Astyanax janeiroensis* and *Jupiaba polylepis*. Reversal in *Astyanax giton*. Ambiguous in *Cheirodon jaguaribensis*. Polymorphic in *Jupiaba scologaster*.

2. Anterior extension of interopercle not surpassing horizontal arm of preopercle [Char. 163: 0 > 1]. Polymorphic in *Astyanax ribeirae* and *Ectrepopterus uruguayensis*.

3. Position of ventral end of posttemporal posterior to epioccipital [Char. 253: 0 > 1]. Independently acquired in *Probolodus heterostomus*. Polymorphic in *Hyphessobrycon moniliger*.

Autapomorphies of *Astyanax giton*

1. Presence of contact between frontals anteriorly to frontal fontanel [Char. 21: 0 > 1]. Independently acquired in *Bario steindachneri* (Eigenmann 1893) and *Deuterodon rosae*. Polymorphic in *Moenkhausia* sp. n and *Cheirodon jaguaribensis*. Ambiguous in *Hyphessobrycon socolofi*.

2. Maxilla not reaching posterior end of Meckelian cartilage [Char. 100: 0 > 1]. Ambiguous in Node 415.

3. One to three cusps Cusps of teeth on the outer premaxillary row [Char. 125: 1 > 0]. Reversal in Node 452 and *Jupiaba scologaster*.

4. Presence of an abrupt decrease in size of dentary teeth [Char. 148: 1 > 0]. Reversal in

Node 455, *Astyanax janeiroensis* and *Jupiaba polylepis*. Polymorphic in *Jupiaba scologaster*. Ambiguous in Node 364 and *Cheirodon jaguaribensis.*

5. Anterior end of branchiostegal rays slender [Char. 214: 0 > 1]. Uniquely derived.

6. Pelvic-fin bony hooks absent in adult males of species bearing hooks on fins [Char. 309: 1 > 0]. Independently acquired in Node 430 and Node 441.

7. Pectoral-fin bony hooks absent in adult males of species bearing hooks on fins [Char. 310: 1 >0]. Reversal.

Astyanax giton was described to rio Paraíba do Sul. In the original description, Eigenmann (1908) characterized *A. giton* as *A. taenitus* (species also described to Rio de Janeiro State) with a short snout, although comparative measurement between the two species' snouts was presented. Eigenmann (1921) redescribed *A. giton* including the two syntypes. Melo (2001) pointed out the overlap of measured values of young specimens of *A. giton* and *A. taeniatus*. The type material of both species was not examined in this analysis.

Autapomorphies of *Astyanax intermedius*

1. Form of fourth infraorbital: (0) approximately squared or more developed longitudinally than dorsoventrally; (1) longer dorsoventrally than longitudinally [Char. 67: 0 > 1]. Independently acquired in Node 362, Node 394, *Hyphessobrycon socolofi* and *Probolodus heterostomus*. Polymorphic in *Bario steindachneri*.

2. Tubules for passage of blood vessels on lamellar portion of maxilla with an anterior branch, parallel to anterior margin of maxilla, reaching one third of its length [Char. 98: 0 > 1]. Independently acquired in *Deuterodon rosae* and *Deuterodon singularis*. Ambiguous in *Deuterodon longirostris*.

3. Teeth from posterior premaxillary row with aligned cusps, without an anterior concavity [Char. 128: 0 > 1]. Polymorphic in *Cheirodon troemneri*.

Autapomorphies of *Astyanax taeniatus*

1. Medial bony ridge of opercle 60% or more than opercular length [Char. 170: 1 > 0]. Independently acquired in *Astyanax hastatus*. Polymorphic in *Hyphessobrycon moniliger*, *Hyphessobrycon pulchripinnis* and *Moenkhausia xinguensis*.

2. Posterior margin of cleithrum with a concavity [Char. 234: 0 > 1]. Reversal in

Node 393, Node 415, Node 456, *Deuterodon singularis*, *Ectrepopterus uruguayensis* and *Hyphessobrycon socolofi*. Polymorphic in *Hyphessobrycon luetkenii*. Ambiguous in Node 361 and Node 448.

Autapomorphies of *Astyanax jenynsii*

1. Articulation antero-ventrally oblique between second and third infraorbitals [Char. 62: 0 > 1]. Polymorphic in *Moenkhausia xinguensis*, *Moenkhausia* sp. n, *Hyphessobrycon moniliger* and *Astyanax ribeirae*. Ambiguous in Node 416, *Ectrepopterus uruguayensis* and *Jupiaba polylepis*.

2. Seventeen or less Number of branched anal-fin rays [Char. 287: 1 > 0]. Independently acquired in *Cheirodon troemneri*.

Autapomorphies of *Astyanax parahybae*

1. Humeral spot absent or vertically elongated [Char. 341: 1 > 0]. Independently acquired in Node 415. Ambiguous in Node 364.

2. Number of 2n chromosomes: (0) 48 or less [Char. 362: 1 > 0]. Polymorphic in *Hyphessobrycon pulchripinnis*.

Ectrepopterus uruguayensis, C. jaguaribensis, H. parana, M.* sp. n*, M. dichroura, M.* cf. *intermedia, B. steindachneri, M. xinguensis, H. moniliger, J. polylepis, J. mucronata, J. scologaster, H. pulchripinnis, H. socolofi, H. takasei, C. troemneri* and *C.* aff. *troemneri

(Clade 366)

1. Length of ascending process of premaxilla reaching just anterior end of nasal [Char. 104: 0>1]. Reversal in Node 393and in Node Node 363. Polymorphic in *Hyphessobrycon socolofi* and *Hyphessobrycon pulchripinnis*.

The most basal species of clade 366 is *Ectrepopterus uruguayensis*. The genus *Ectrepopterus* Fowler, 1943 was described as a new subgenus and species of *Megalamphodus* Eigenmann. *Ectrepopterus* was tentatively considered a junior synonym of *Hyphessobrycon*, along with *Megalamphodus* by Weitzman & Palmer (1997). Thomaz *et al*. (2010) referred *Hyphessobrycon uruguayensis* on a list of possible rosy tetras in the molecular study; however, this species was not found closely related to the rosy tetra clade (*sensu* Weitzman & Palmer, 1997), making the decision to synonymize *Ectrepopterus* to *Hyphessobrycon* doubtful. Recently, *Ectrepopterus* was revalidated by Malabarba *et al*. (2012) when they pointed out a close relationship with *Nematobrycon* Eigenmann one of the genera of the subfamily Gymnocharacinae proposed by Mirande (2010) and *Probolodus* in a large polytomy, and excluding *H. compressus*.

Mirande (2009) nominated the diverse assemblage including some specious genera, such as the true *Hemigrammus* and *Hyphessobrycon*, related to the probable monophyletic "rosy tetra clade" of Weitzman & Palmer (1997), and the true *Moenkhausia*, along with some less diverse and morphologically more divergent genera, such as *Deuterodon*, *Probolodus*, and *Thayeria*, and nominated this clade as "*Hemigrammus* Clade". In Mirande (2010) the majority of the *Hemigrammus* species clade are present in the Tetragononpterinae clade.

Carvalho (2011) redefined the *Hyphessobrycon* genus *stricto sensu* based on the analysis of *H. compressus*. The new monophyletic clade included: *H. compressus*, *H. pulchripinnis*, *H. hasemani* Fowler, 1913, *H. haraldschultzi*, *Cheirodon troemneri*, *C.* aff. *troemneri*, *H. copelandi*, *H. takesei*, *H. minor*, *H. micropterus*, *H. rosaceus*, *H. megalopterus*, *H. bentosi*, *H. eques*, *H. sweglesi*, *H. werneri*, *H. epicharis*, *H. socolofi*, *H. pyrrhonotus* and *H. erythrostigma.*

The clade 395, in the present analyzes, corroborated partly the results of Carvalho's, presenting part of the monophyletic group of *Hyphessobrycon sensu stricto* species (*H. pulchripinnis*, *H.* s*ocolofi*, *H. takesei*, *Cheirodon troemneri* and *C.* aff. *troemneri*), although the internal relationships between the species are different.

Although, the monophyly and relationships of *Moenkhausia* lie beyond the scope of this work, *Moenkhausia xinguensis*, the type species of the genus, is included in the Clade 363 herein with *Bario steindachneri*, *Moenkhausia* sp. n, *M. dichroura* and *M.* cf. *intermedia,* and the relationships between *Cheirodon jaguaribensis* and *Hemmigrammus parana* are the same in this work and in Carvalho (2011). This is an indication that is needed for further studies encompassing these species in order to find a possible monophyletic group.

Some Comments about Clade 356

Astyanax janeiroensis*, *A*. *chico* and *A*. *troya

1. Presence of branching of laterosensory canals of fourth or fifth infraorbitals [Char. 74: 0 > 1]. Independently acquired in Node 452. Polymorphic in *Astyanax ribeirae*, *Deuterodon iguape*, *Hyphessobrycon pulchripinnis*, *Moenkhausia xinguensis*, and *Probolodus heterostomus.*

Although *Astyanax janeiroensis* has being designated to Rio de Janeiro by Eigenmann (1908) in the original description, the same author in 1921 cited the occurrence of this species in Morretes and Ribeira de Iguape. Lima *et al*. (2003), pointed out the distribution to "Eastern Brazil (?)". For this analysis, the type material of *Astyanax janeiroensis* was observed, though a high number of characters were not encoded in matrix, and in final resolution of phylogeny this was the only species herein analyzed from eastern Brazil excluded of clade (polytomy) of *Astyanax*. This result needs to be reevaluated in further works, with more material.

Autapomorphies of *Astyanax janeiroensis*

1. Supraoccipital spine projected just to anterior axis of neural complex [Char. 53: 0 > 1]. Reversal in *Deuterodon langei*. Ambiguous in Node 361, Node 414, Node 451, and Node 458.

2. Presence of abrupt decrease in size of dentary teeth [Char. 148: 0 > 1]. Independently acquired in Node 455 and *Jupiaba polylepis*. Reversal in *Astyanax giton*. Ambiguous in Node 364 and *Cheirodon jaguaribensis*. Polymorphic in *Jupiaba scologaster*.

3. Two (adnates) dorsal-fin rays on last pterygiophore [Char. 272: 0 > 1]. Independently acquired in Node 454 and Node 457.

4. Four or less of supraneurals [Char. 280: 1 > 0]. Independently acquired in Node 365. Reversal in *Bario steindachneri*. Polymorphic in *Cheirodon jaguaribensis, Cheirodon* aff. *troemneri*, *Deuterodon iguape* and *Moenkhausia dichroura*.

General discussion

There is a well corroborated large monophyletic unit among characids that include all species lacking a supraorbital (Malabarba & Weitzman, 2003; Javonillo *et al*., 2010; Mirande, 2010). The recognition of the subfamilies Aphyocharacinae, Characinae, and Cheirodontinae seem to be congruent at some level within different studies (Malabarba, 1998a; Calcagnotto *et al*., 2005; Javonillo *et al*., 2010; Mirande, 2010), as well as, the *Hyphessobrycon sensu* Carvalho (2011). The characid group of species with unclear phylogeny remains in some of the genera placed in Tetragonopterinae by Eigenmann (1921) and Géry (1977), including three of the most species rich genera of the Characidae: *Astyanax*, *Hemigrammus* and *Moenkhausia*.

In the present analysis, we propose a monophyletic clade including species of different genera. The characters responsible to group these taxa are related with secondary sexual features herein represented by the presence of bone hooks in mature males (in different fins) determined the clade 368 and clade 367, the most inclusive clades. The largest clades were related by synapomorphies evolving the presence of bony hooks of males mature fins, this character is considerated weak, once that many lots of material examined cannot represent males in the reproductive stage. Although this character is present, to determinate the main relationships among the species, it is absent in *Deuterodon* clade and reversed in some *Astyanax* species analyzed.

However, the main contribution of this work is the evidence of a monophyletic clade (452), proposed in previous studies that pointed out the close relationship of *H. luetkenii* with other species of *Astyanax* and *Deuterodon* (Lucena 1992, 2002; Melo, 2001).

Once more time was corroborated, it was determined that the lateral line completeness is was not a good character to diagnose genera. This character was not considerated strong and consistent synapormophy to group *H. luetkenii*, the unique species with the lateral line interrupted in the monophyletic clade. This character is an autapomorphy to species, and does not present any influence in determinating the relationships with other taxon. Eigenmann (1917) delineated this character with two states: "lateral line complete" *vs*. "lateral line incomplete" as an outer line separating the genera with an interrupted lateral line. An interrupted lateral line defined, according to Eigenmann (1917), *Brycochandus* Eigenmann (= *Bryconops* Kner - in part), *Hasemania*, *Hemigrammus*, *Hollandichthys* Eigenmann, *Hyphessobrycon*, *Nematobrycon*, *Pristella*, *Psellogrammus*, *Pseudochalceus* Kner and *Thayeria*; however, these groups are not closely related to each other, according to the figure of Eigenmann, but rather originated from different lines of evolution. Malabarba (1998a) and Mirande (2010) agree with Eigenmann (1917) in that the loss of a complete lateral line is more common than reacquisition of a complete one. Although, the phylogenetic definition of *Astyanax* is still unclear, based on relations of clade 457 (compressing *H. lutekenii*, *A. ribeirae*, *A. hastatus*, *A. giton*, *A. intermedius*, *A. taeniatus*, *A. jenynsii* and *A. parahybae*), we propose herein a new taxonomic classification, *Hyphessobrycon luetkenii* should be removed of *Hyphessobrycon* genus and placed along with *A. ribeirae*, *A. hastatus*, *A. giton*, *A. intermedius*, *A. taeniatus*, *A. jenynsii* and *A. parahybae* in the genus *Astyanax*.

Other character tested in this analysis, the "teeth of the sides of the dentary abruptly smaller" *vs*. "teeth of the sides of the dentary graduated" was found homoplastic, in accordance with Mirande (2010), showing a weak influence to support the clades. This character proved to be very homoplastic with a low ci (= 4). This character presented a plesiomorphic behavior in general cladogram, being considerated apomorphic in clades or taxa with the size of dentary teeth decreasing abruptly. However, the character 125 and character 139, related to the number of cusps in the outer row of the premaxillary teeth and maxillary teeth grouped *Deuterodon* + *H. luetkenii* + *Astyanax* spp. as monophyletic. Conclusively, the monoplyletism of *Deuterodon* was proved in both optimizations used here.

Comparative material. *Astyanax eigenmanniorum*: ANSP 21598, holotype, 54.2 mm SL, Rio Grande do Sul. ANSP 21627-21628, paratypes, 2, 43.4-51.0 mm SL, collected with holotype. ANSP 21599-21601, paratypes, 3, 38.3-49.7 mm SL, collected with holotype. ANSP 21602, paratype, 1 c&s, collected with holotype. *Astyanax giton*: MCP 34420, 1 c&s, 49.2 mm SL, córrego Boa Vista, tributary of rio Itabapoana, Mimoso do Sul, Espiríto Santo. MCP 36771,1 c&s, 31.1 mm SL, córrego Palmares, tributary of do rio Itaúnas, Pinheiros, Bahia. UFRGS 14814, 2 c&s, 47.9-49.9 mm SL, córrego Latão, tributaty of Rio Doce, Coimbra, Minas Gerais. *Astyanax hastatus*: UFRGS 10257, 2 c&s, 49.3-49.9 mm SL, Macacu, Rio de Janeiro.USNM 94312, paratypes, 15, 22.02-37.0 mm SL, Southeastern Brazil. *Astyanax intermedius*: UFRGS 10821, 2 c&s, 59.3-62.5 mm SL, Santa Virginia, São Paulo. *Astyanax janeiroensis*: MCZ 21057, holotype, 72.0 mm SL, Rio de Janeiro. UFRGS 13690, 1, 73.8 mm SL, córrego on the road, Iguape, São Paulo. *Astyanax jenynsii*: NMW 576534, syntypes, 3, 62,3-72.8 mm SL, rio Parahyba. *Astyanax luetkenii*: BMNH 1886.3.15.35, lectotype, 1, 55.8 mm SL, San Lorenzo, Rio Grande do Sul, Brazil; BMNH 1886.3.15.36-38, 3, 55.9-62.5 mm SL, collected with lectotype; BMNH 1885.2.3.78-79, paralectotypes 2, 34.3-35.6 mm SL, collected with lectotype; DZSJRP 12117, 2 c&s, 35.3-37.53 mm SL, arroio Olaria, Bonito, Mato Grosso; UFRGS 5270, 5 c&s, 34.7-54.2 mm SL, lagoa do Palácio, Viamão, Rio Grande do Sul; UFRGS 5294, 2 c&s, 33.1-35.3 mm SL, arroio do Salso, Rosário do Sul, Rio Grande do Sul. *Astyanax parahybae*: MCZ 157903, paralectotypes, 5, 79.3-98.3 mm SL, rio Parahyba, Mendez, Miriahe and Taubeté, USNM 120245, syntypes, 3, 86.3-96.6 mm SL, collected with paralectotypes. *Astyanax ribeirae*: MCP 15397, 3 c&s, 31.9-36.3 mm SL, rio Côrrea, Tubarão, Santa Catarina. MCP 15468, 3 c&s, 37.4-41.9 mm SL, arroio Lindo, Joinville, Santa Catarina. MCP 22308, 3 c&s, 29.0-35.7 mm SL, rio Antinhas, Santa Catarina. MCP 31758, 3 c&s, 37.3-40.8 mm SL, arroio on the PR 404 in the way to Guaraqueçaba, Paraná. UFRGS 12549, 2 c&s, 36.6-40.1 mm SL, rio Jordão, Nova Veneza, Santa Catarina. *Astyanax taeniatus:* MCP 27322, 3, 52.9-55.6 mm SL, Itarana, Espírito Santo. UFRGS 10408, 1, 72.5 mm SL, rio Pandeiros, Januária, Minas Gerais. *Deuterodon iguape*: MCP 20914, 2 c&s, 32.1-61.1 mm SL, rio Betari, Iporanga, São Paulo. UFRGS 10352, 2 c&s, 38.8-52.7 mm SL, rio Cachoeira da Anta, Peruíbe, São Paulo. *Deuterodon langei*: MCP 13965, 2 c&s, 50.3-64.7 mm SL, rio São João, Pedra Branca, Paraná. *Deuterodon longirostris*: MCP 12205, 2 c&s, 72.8-73.8 mm SL, rio do Cedro, Águas Mornas, Santa Catarina. NMW 57633, syntypes, 3, 69.1-75.0 mm SL, rio Cubatão, Santa Catarina, Theresopolis. *Deuterodon rosae*: MCP 12209, 1 c&s, 86.0 mm SL, arroio afluente do rio Itapocu, Corupa, Santa Catarina. *Deuterodon singlaris*: MCP 11084, paratype,1 c&s, 60.3 mm SL, rio Capivari, Gravatal Santa Catarina. *Deuterodon stigmaturus*: MCP 14678, 2 c&s, 45.6-70.6 mm SL, rio Maquiné, Maquiné, Rio Grande do Sul. *Deuterodon supparis*: MCP 10622, paratypes, 2 c&s, rio Itajaí-Açu, Santa Catarina.

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Table 1. Results of the IW analysis under different parameters. Trees used for the final phylogenetic hypothesis are in bold.

	"k"-values	Number of trees	Steps	Best score	Tree-Fit	SPR distances	Average character fit (F)	Average homoplasic steps (S)
K0	6.9375	108	2781	178.01	176.98	1883	0.50	6.9375
K1	7.5156	486	2768	178.29	176.74	1756	0.52	6.9375
K2	8.1440	108	2760	178.38	176.61	2021	0.54	6.9375
K3	8.8295	81	2755	178.35	176.64	1751	0.56	6.9375
K4	9.5803	162	2744	178.52	176.47	1278	0.58	6.9375
K5	10.4062	81	2732	178.80	176.19	1223	0.60	6.9375
K6	11.3190	54	2726	179.09	175.90	1304	0.62	6.9375
K7	12.3333	81	2721	179.13	175.86	1216	0.64	6.9375
K8	13.4669	81	2721	179.13	175.86	1216	0.66	6.9375
K9	14.7421	27	2708	179.41	175.41	990	0.68	6.9375
K10	16.1875	27	2707	179.44	175.55	1137	0.70	6.9375
K11	17.8392	486	2702	179.45	175.54	997	0.72	6.9375
K12	19.7451	486	2697	179.75	175.24	951	0.74	6.9375
K13	**21.9687**	**486**	**2695**	**179.81**	**175.18**	**945**	**0.76**	**6.9375**
K14	**24.5965**	**486**	**2695**	**179.81**	**175.18**	**945**	**0.78**	**6.9375**
K15	27.7500	27	2690	180.27	174.720	1302	0.80	6.9375
K16	31.6041	243	2682	180.57	174.42	1233	0.82	6.9375
K17	36.4218	27	2690	180.11	174.88	1282	0.84	6.9375
K18	42.6160	243	2680	180.56	174.43	1116	0.86	6.9375
K19	50.8750	27	2675	180.91	174.08	1199	0.88	6.9375
K20	62.4375	36	2669	181.63	173.36	1634	0.90	6.9375

Fig. 1. USNM 94312, *Astyanax hastatus*, paratypes, collected in the "vicinity of Rio de Janeiro, Brazil".

Fig. 2. MCZ 21057, *Astyanax janeiroensis*, holotype, Rio de Janeiro, Brazil.

Fig. 3. NMW 57534.1-3, *Astyanax jenynsii*, syntypes, rio Paraiba do Sul, Brazil.

Fig. 4. MCZ 157903, *Astyanax fasciatus parahybae*, paralectotype, rio Paraiba, Rio de Janeiro State, Brazil.

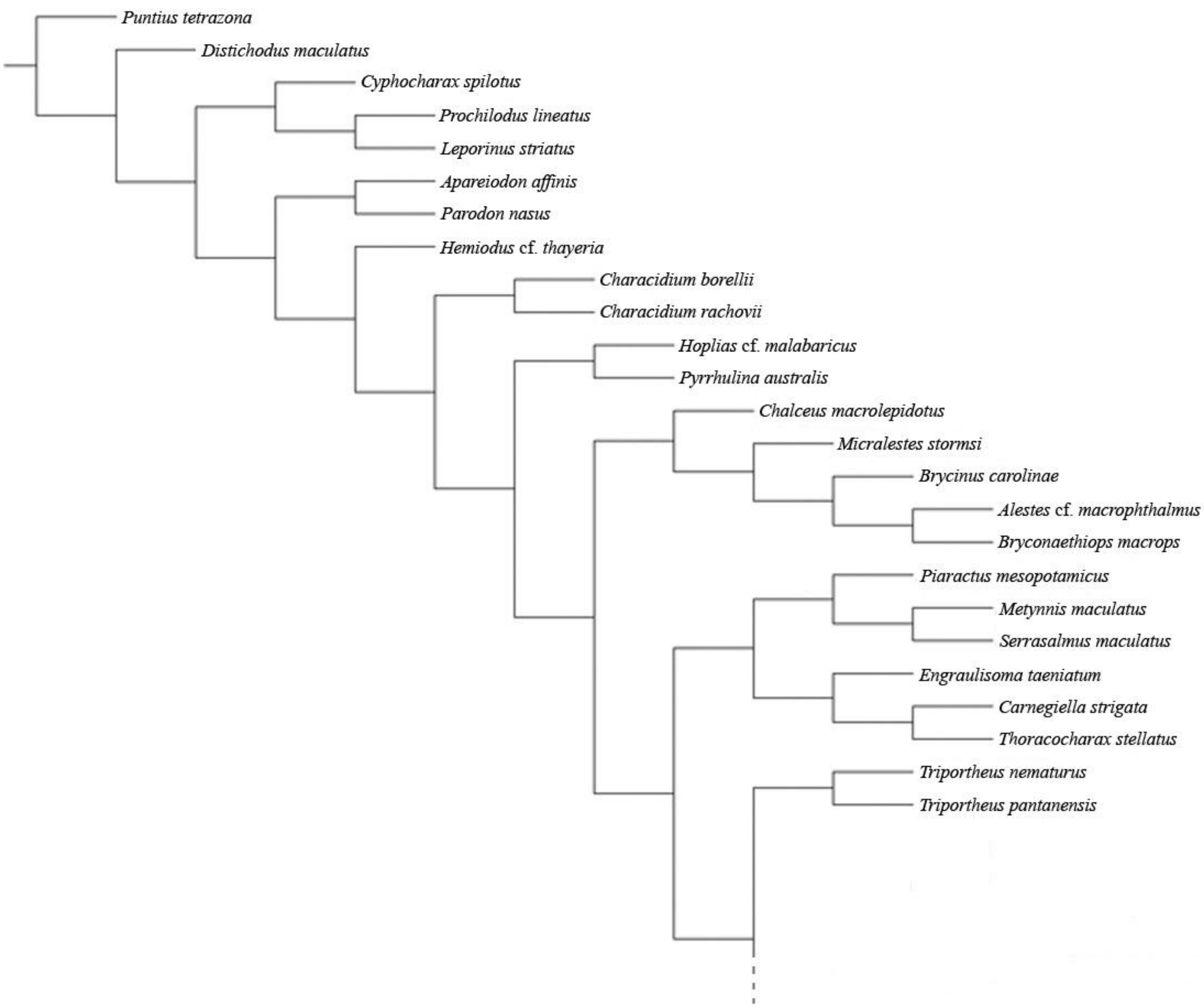

Fig. 5. Strict consensus tree resulted from equal weighted parsimony analysis with 2664 steps (CI = 14; RI = 66), obtained from 3 equally parsimonious trees with 2682 steps (CI =14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

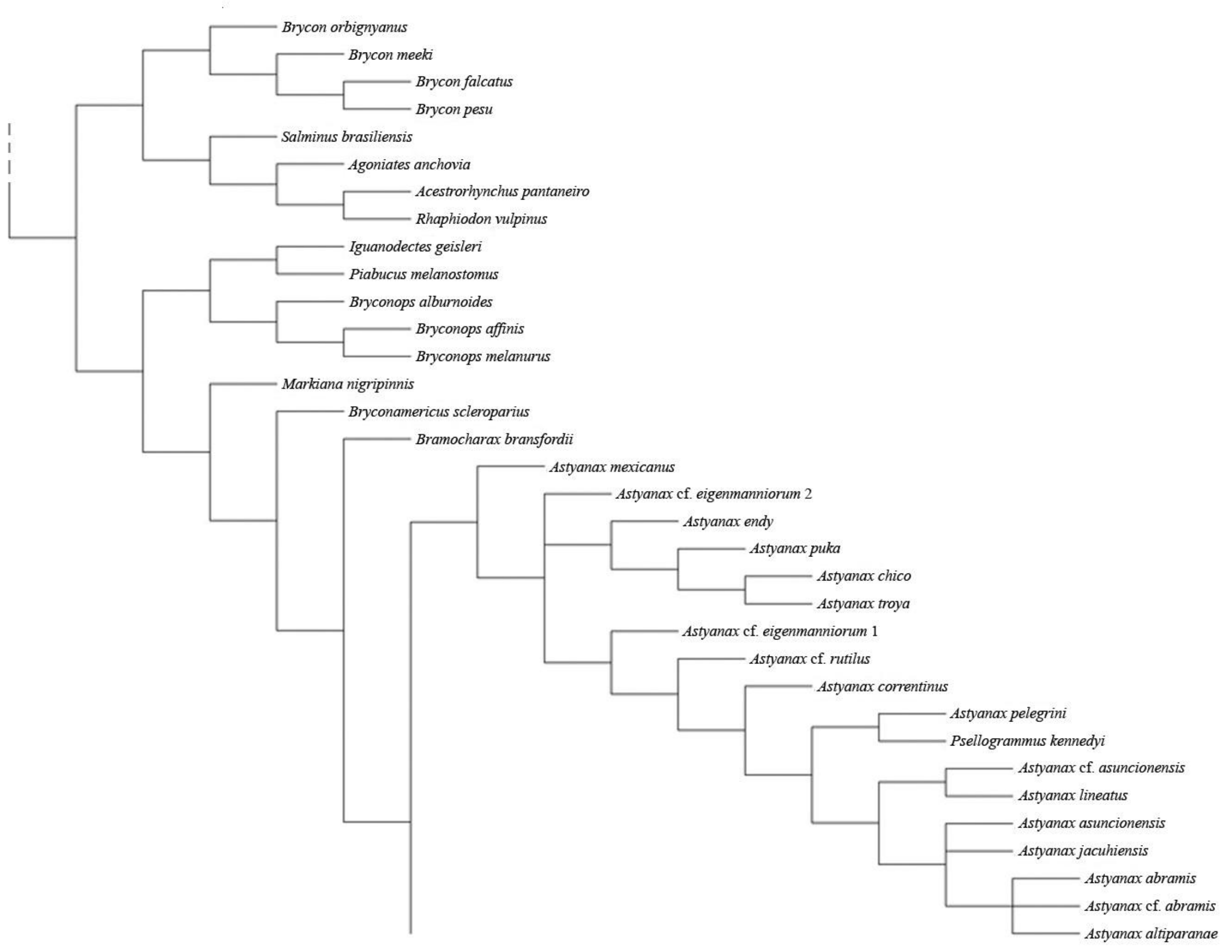

Fig. 5 (cont.). Strict consensus tree resulted from equal weighted parsimony analysis with 2664 steps (CI = 14; RI = 66), obtained from 3 equally parsimonious trees with 2682 steps (CI = 14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

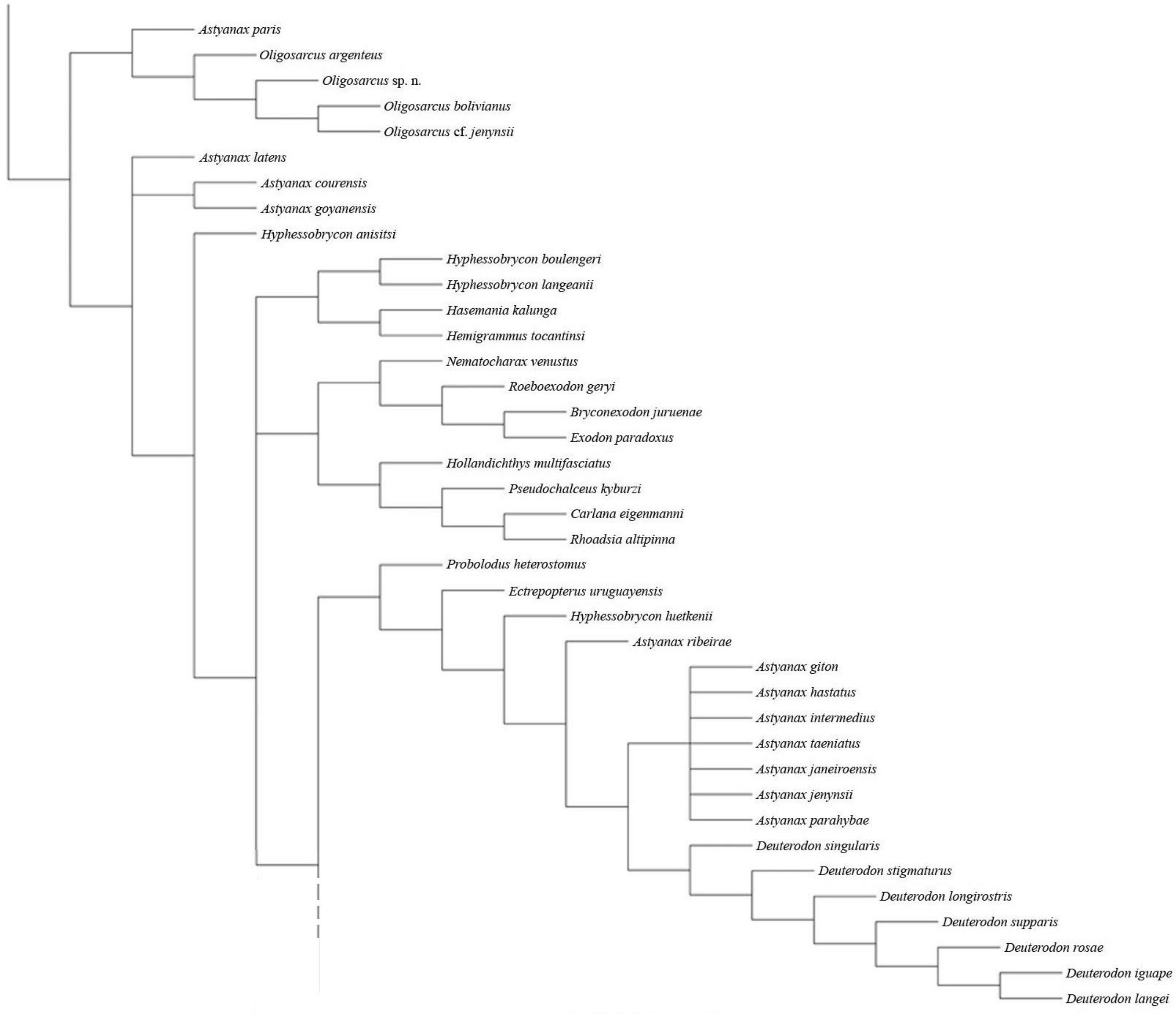

Fig. 5 (cont.). Strict consensus tree resulted from equal weighted parsimony analysis with 2664 steps (CI = 14; RI = 66), obtained from 3 equally parsimonious trees with 2682 steps (CI = 14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

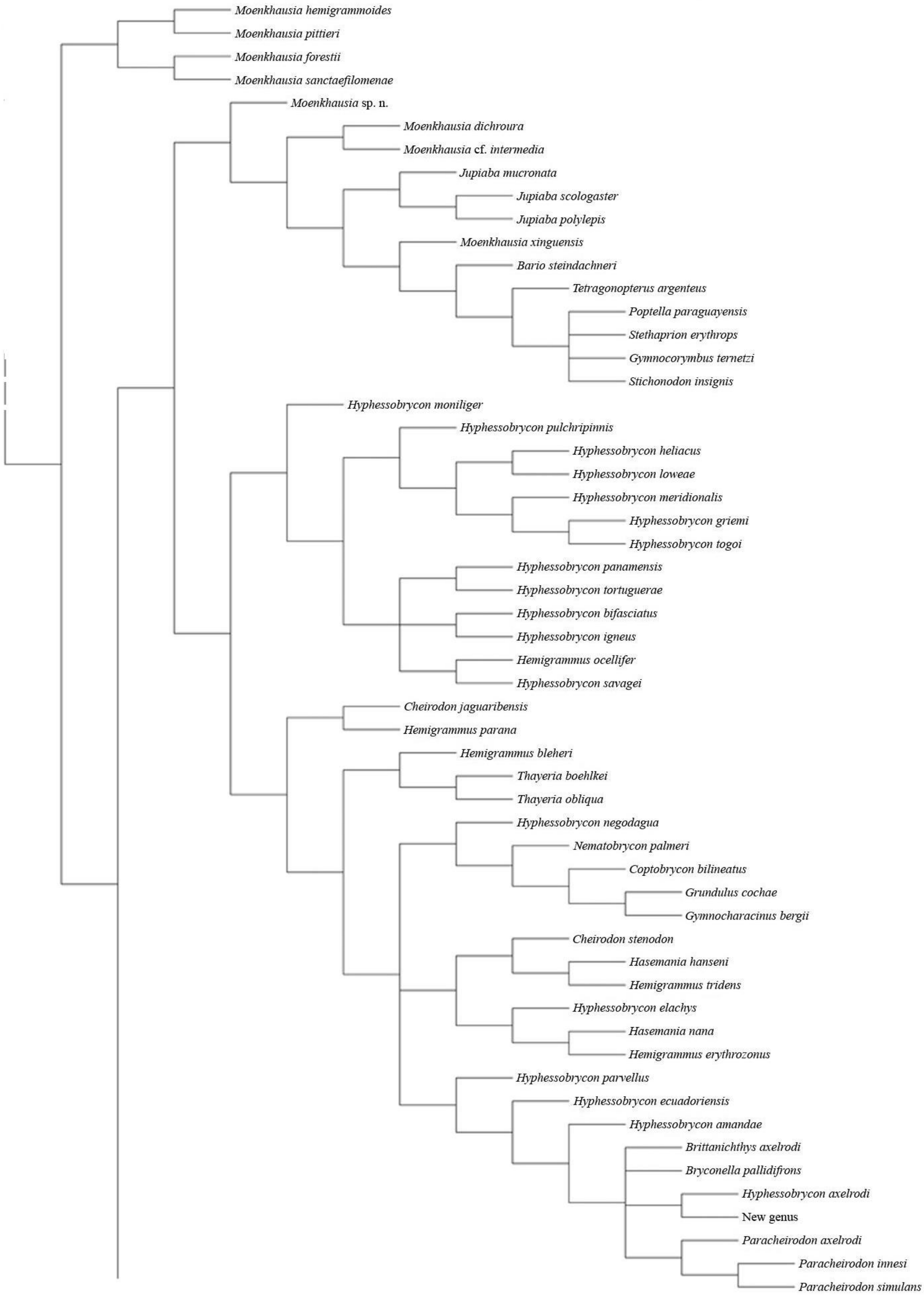

Fig. 5 (cont.). Strict consensus tree resulted from equal weighted parsimony analysis with 2664 steps (CI = 14; RI = 66), obtained from 3 equally parsimonious trees with 2682 steps (CI = 14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

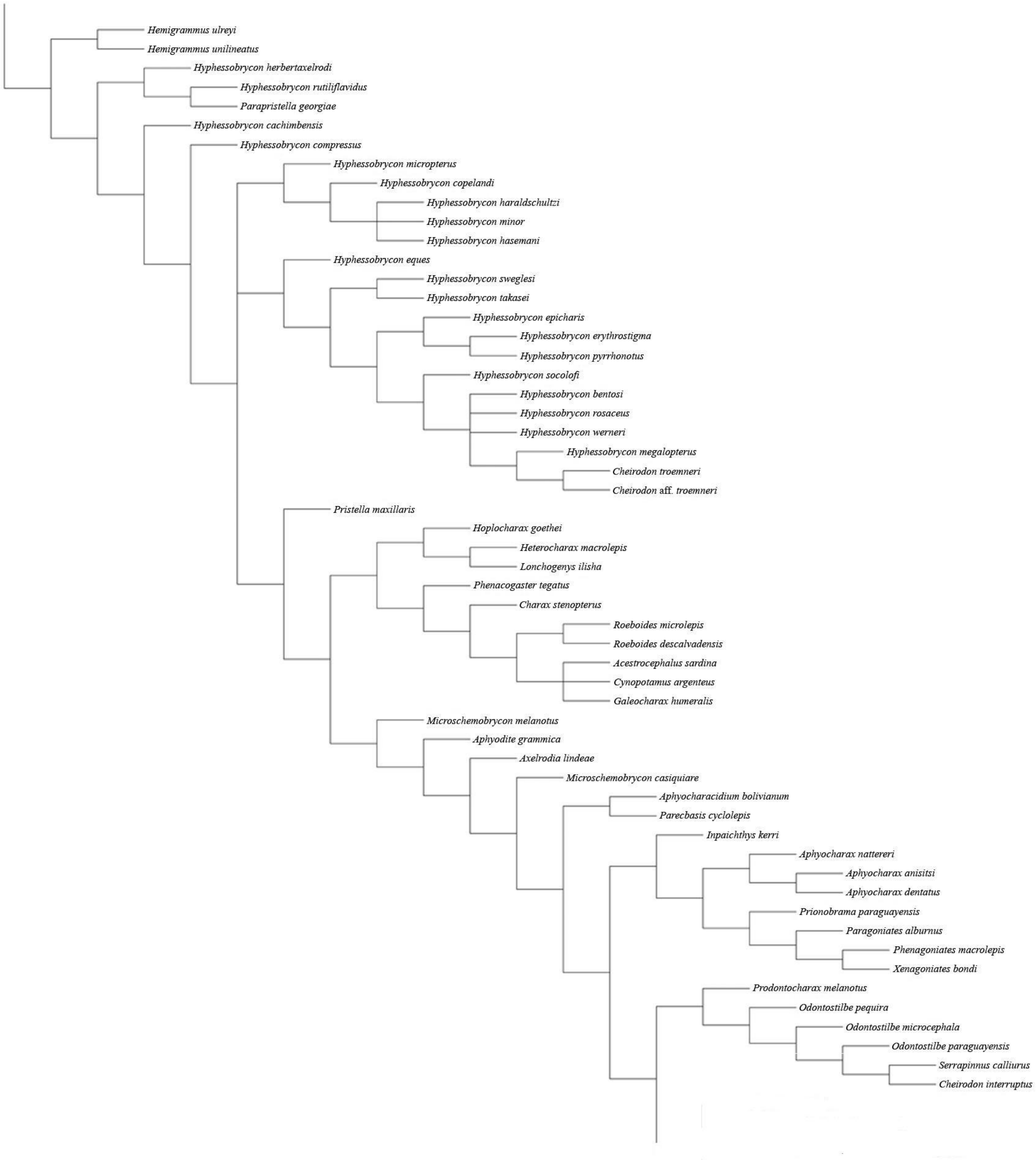

Fig. 5 (cont.). Strict consensus tree resulted from equal weighted parsimony analysis with 2664 steps (CI = 14; RI = 66), obtained from 3 equally parsimonious trees with 2682 steps (CI = 14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

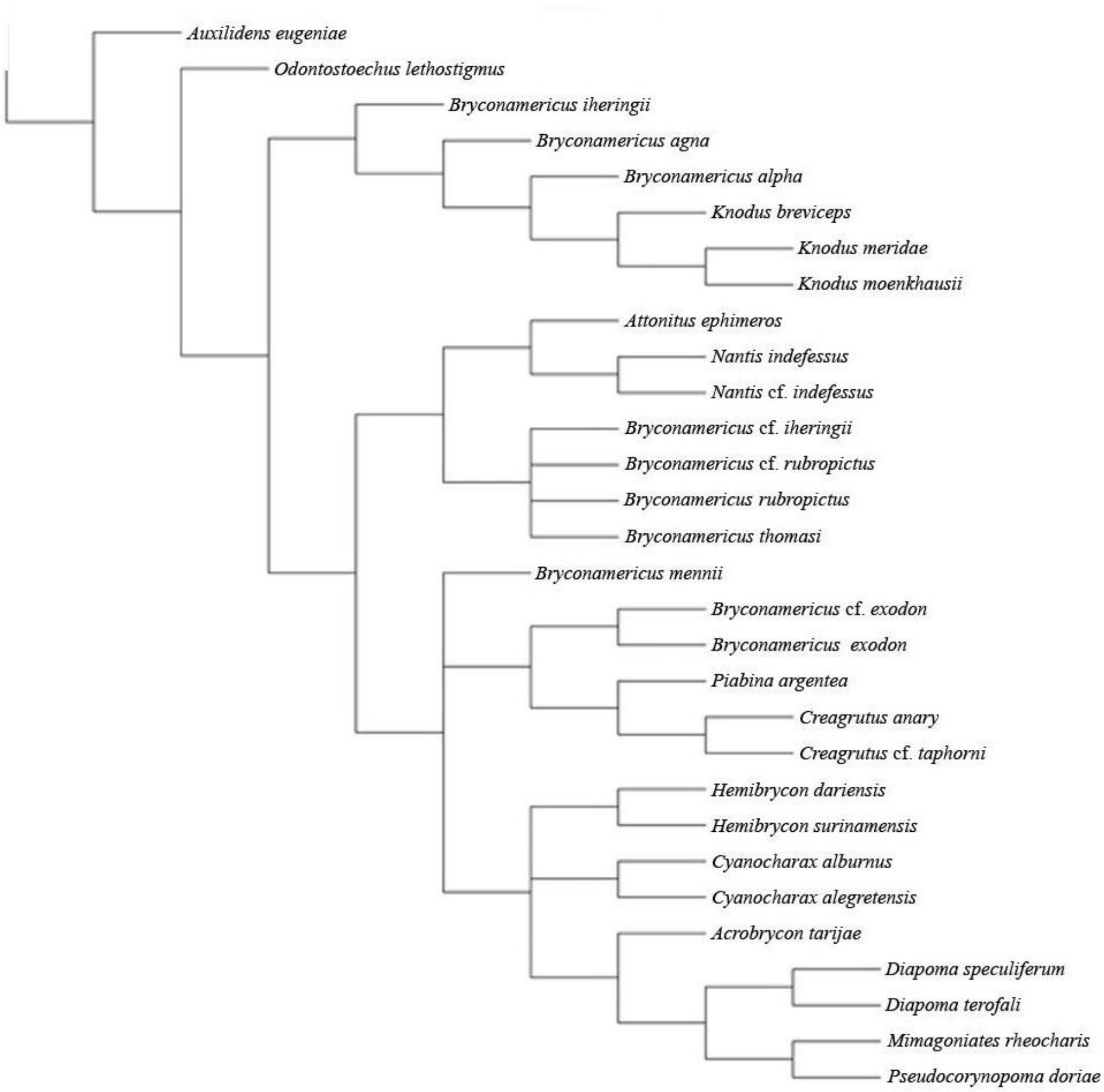

Fig. 5 (cont.). Strict consensus tree resulted from equal weighted parsimony analysis with 2664 steps (CI = 14; RI = 66), obtained from 3 equally parsimonious trees with 2682 steps (CI = 14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

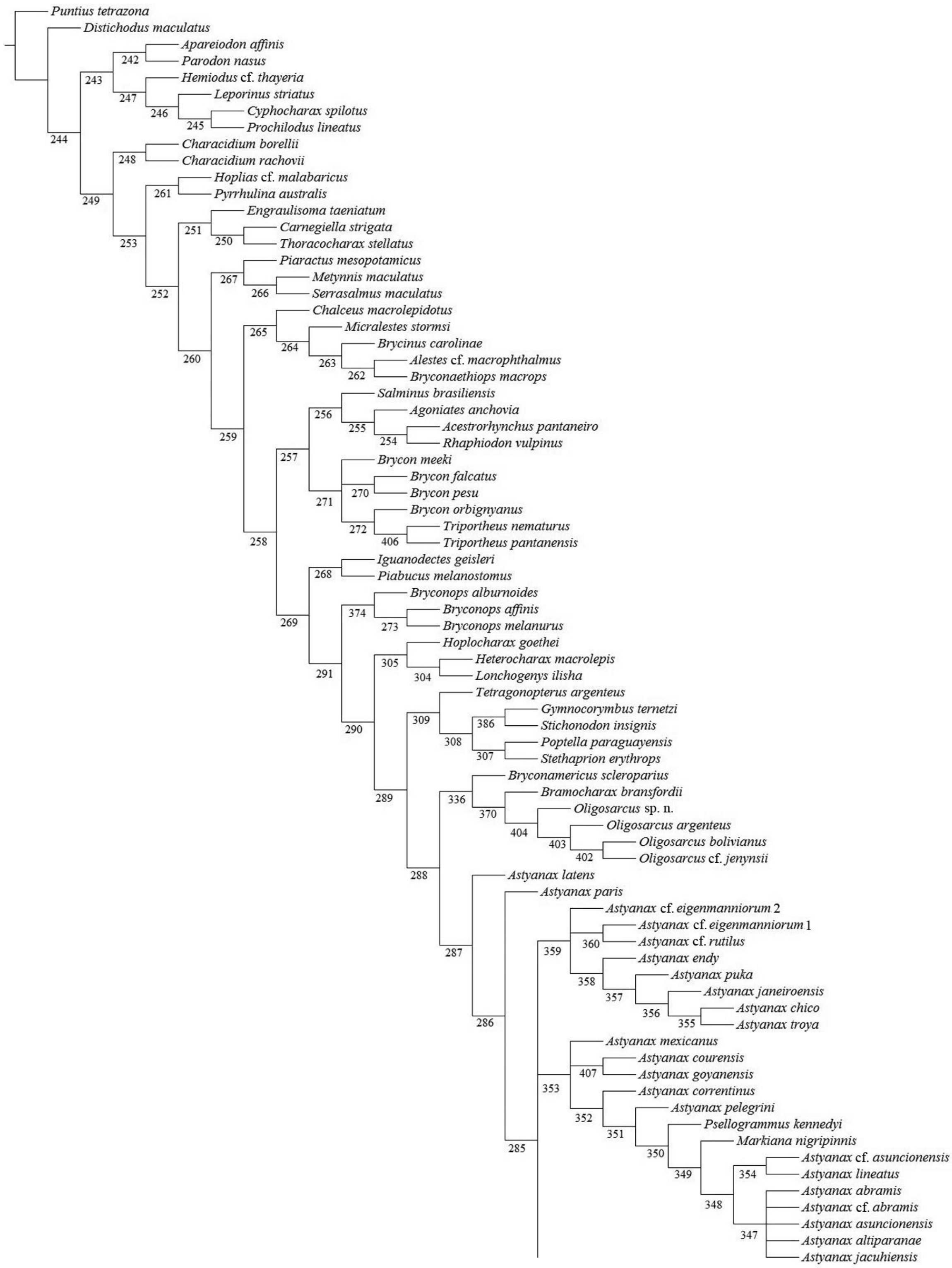

Fig. 6. Strict consensus tree resulted from IW analysis obtained from "k" = 21.9687 and 24.5965, from 972 equally parsimonious trees with 2702 steps (CI = 14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

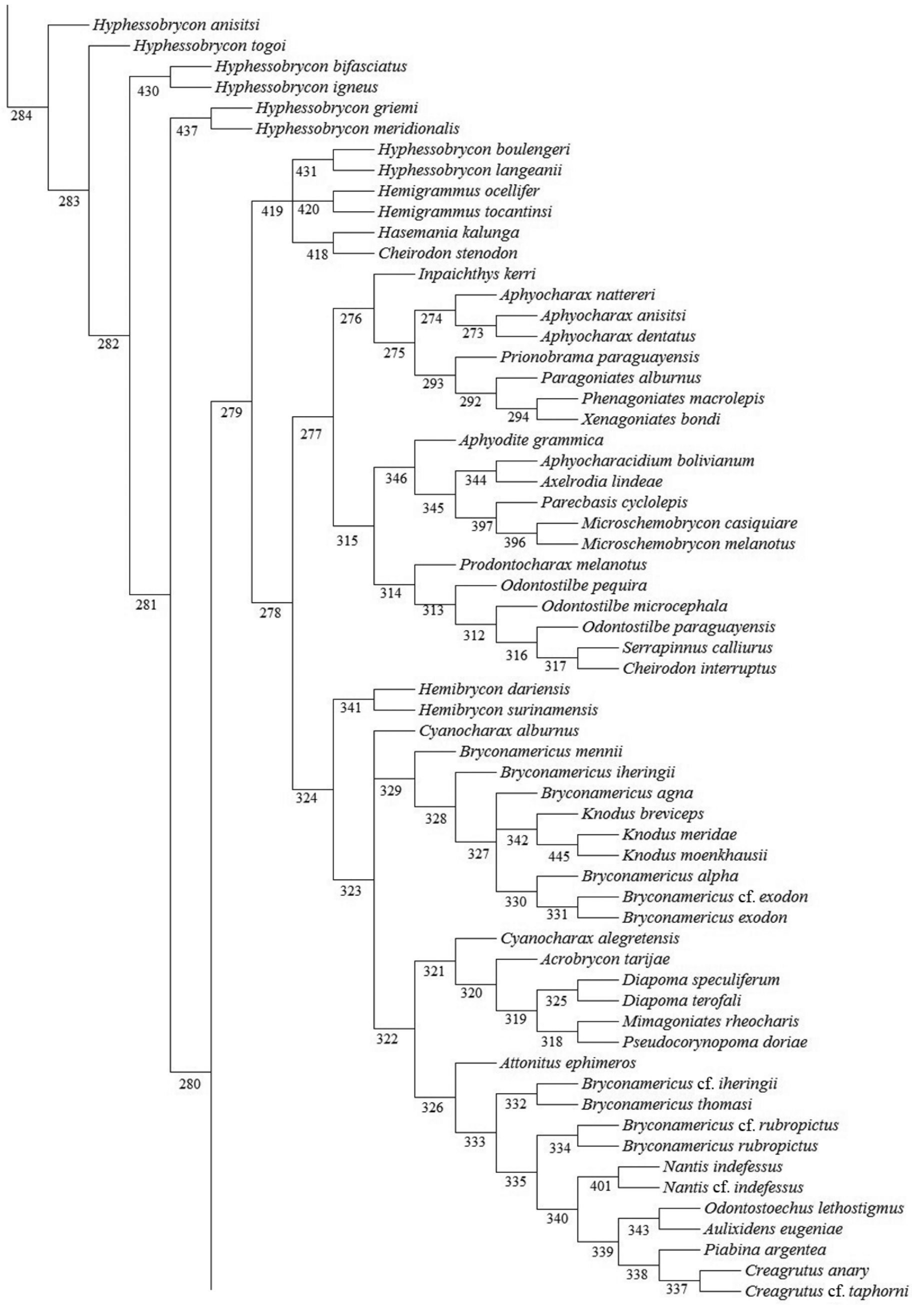

Fig. 6 (cont.). Strict consensus tree resulted from IW analysis obtained from "k" = 21.9687 and 24.5965, from 972 equally parsimonious trees with 2702 steps (CI = 14; RI = 65), representing the hypothesis of relationship for the "*A. ribeirae* clade".

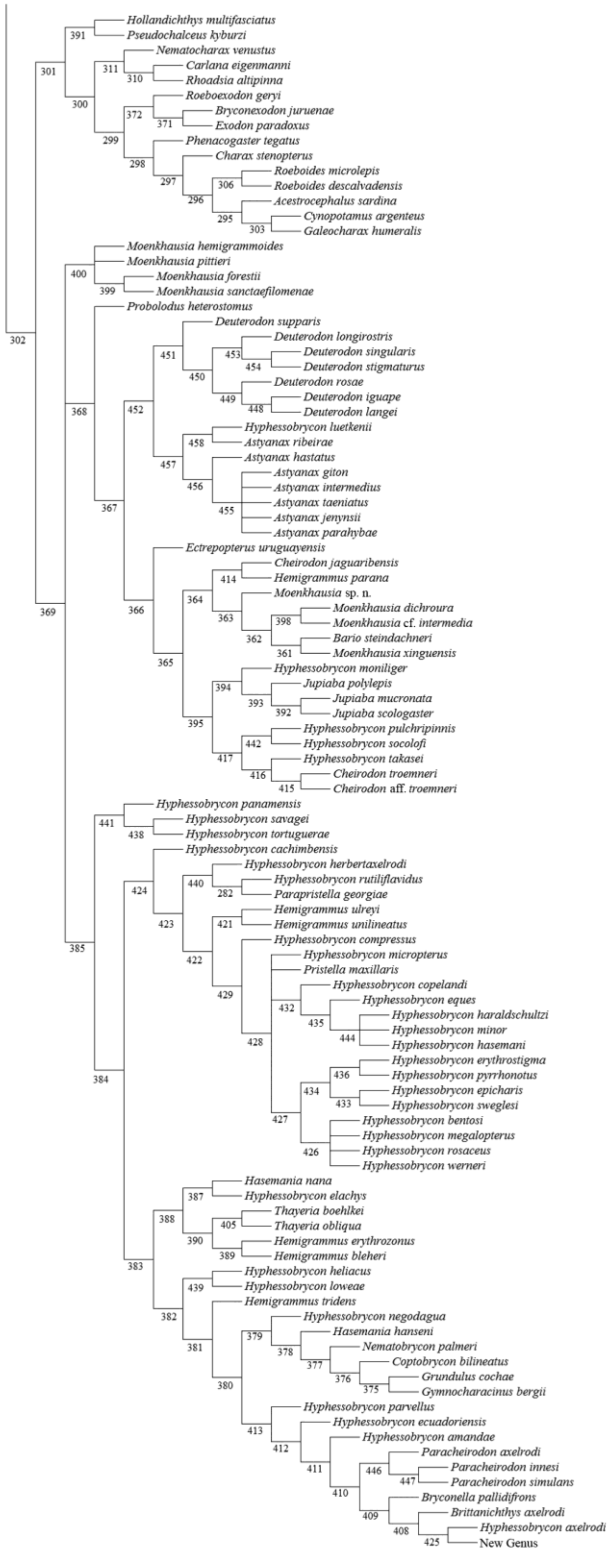

Fig. 6 (cont.). Strict consensus tree resulted from IW analysis obtained from "k" = 21.9687 and 24.5965, from 972 equally parsimonious trees with 2702 steps (CI = 14; RI = 65), representing the hypothesis of relationship the "*A. ribeirae* clade".

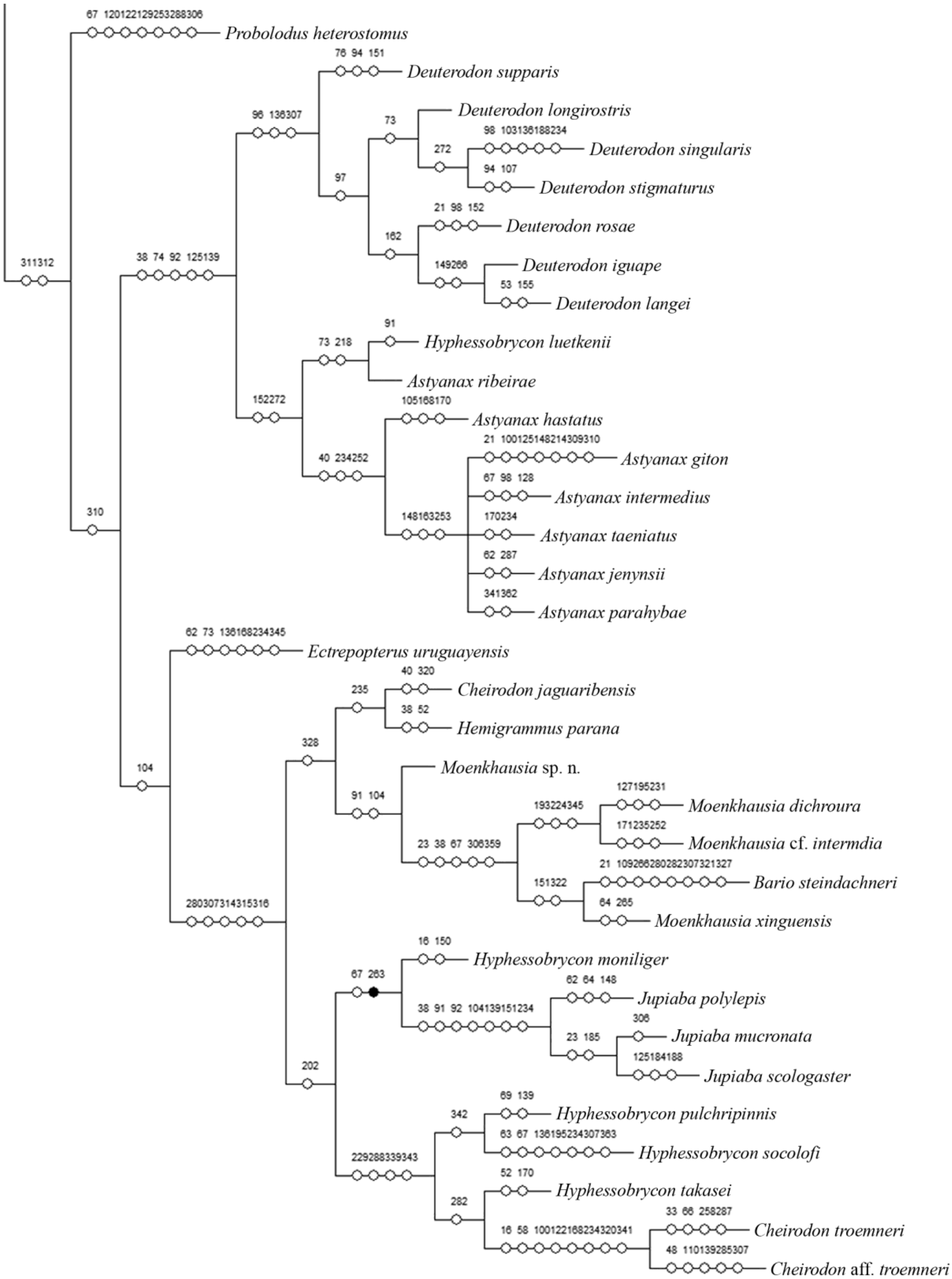

Fig. 7. Hypothesis of relationships of the Strict consensus tree from IW Analysis of the "*A. ribeirae* clade" based in unambiguous characters.

Fig. 8. Equal weighted parsimony hypothesis of relationship for the "*A. ribeirae* clade" and outgroup taxa, including Bremer support values in the clades. Based on 127.278 suboptimal trees generated by TBR.

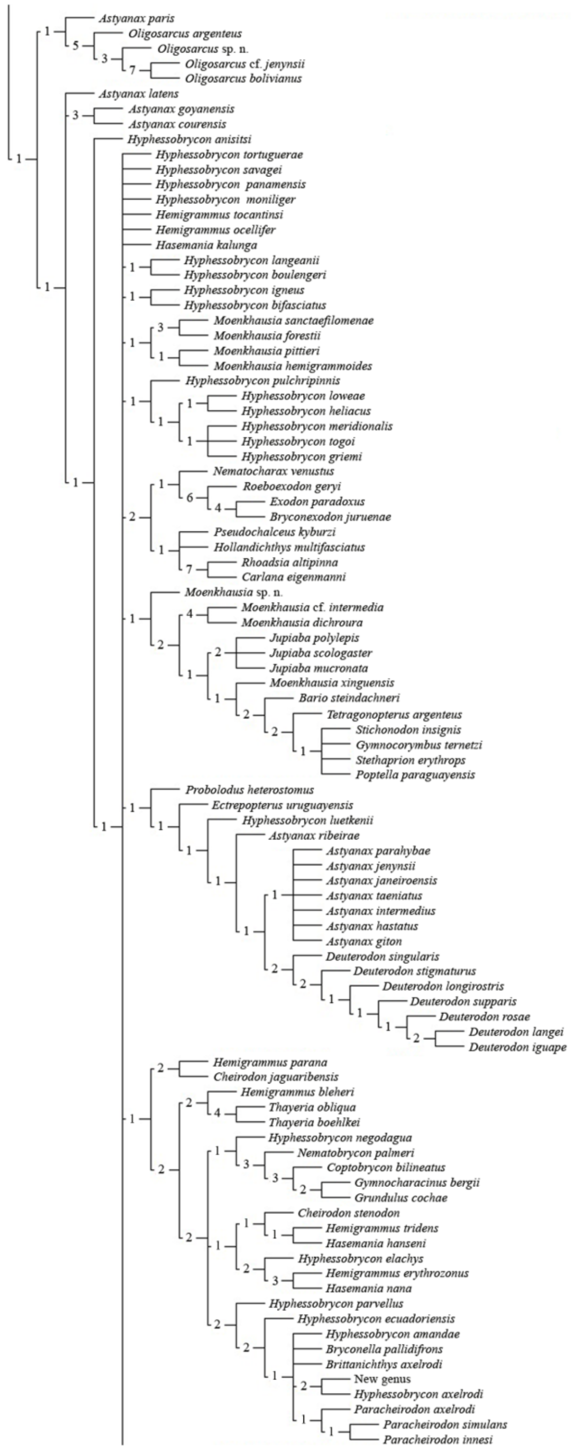

Fig. 8 (cont.). Equal weighted parsimony hypothesis of relationship for the "*A. ribeirae* clade" and outgroup taxa, including Bremer support values in the clades. Based on 127.278 suboptimal trees generated by TBR.

Fig. 8 (cont.). Equal weighted parsimony hypothesis of relationship for the "*A. ribeirae* clade" and outgroup taxa, including Bremer support values in the clades. Based on 127.278 suboptimal trees generated by TBR.

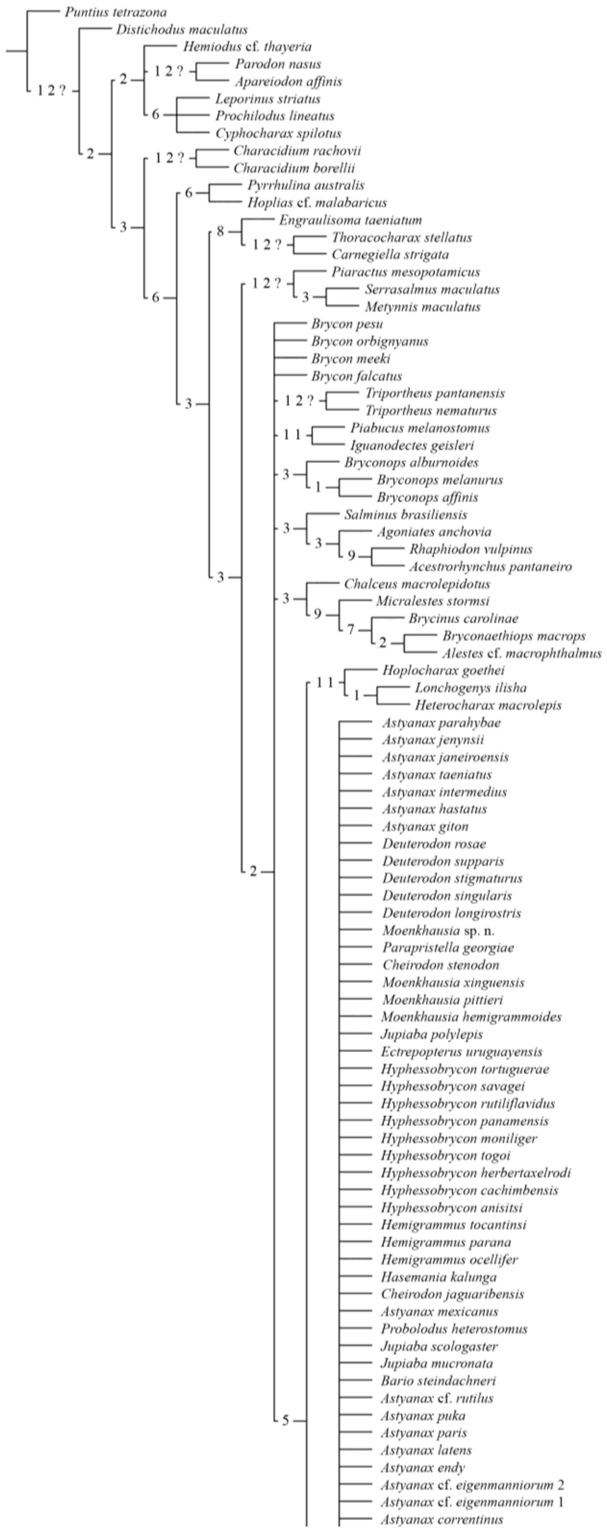

Fig. 9. Hypothesis of relationship for the "*A. ribeirae* clade" and outgroup taxa obtained fromimplied weighted analysis under "k" = 11.51, including absolute Bremer support values in the clades. Based on 122.679 suboptimal trees generated by TBR.

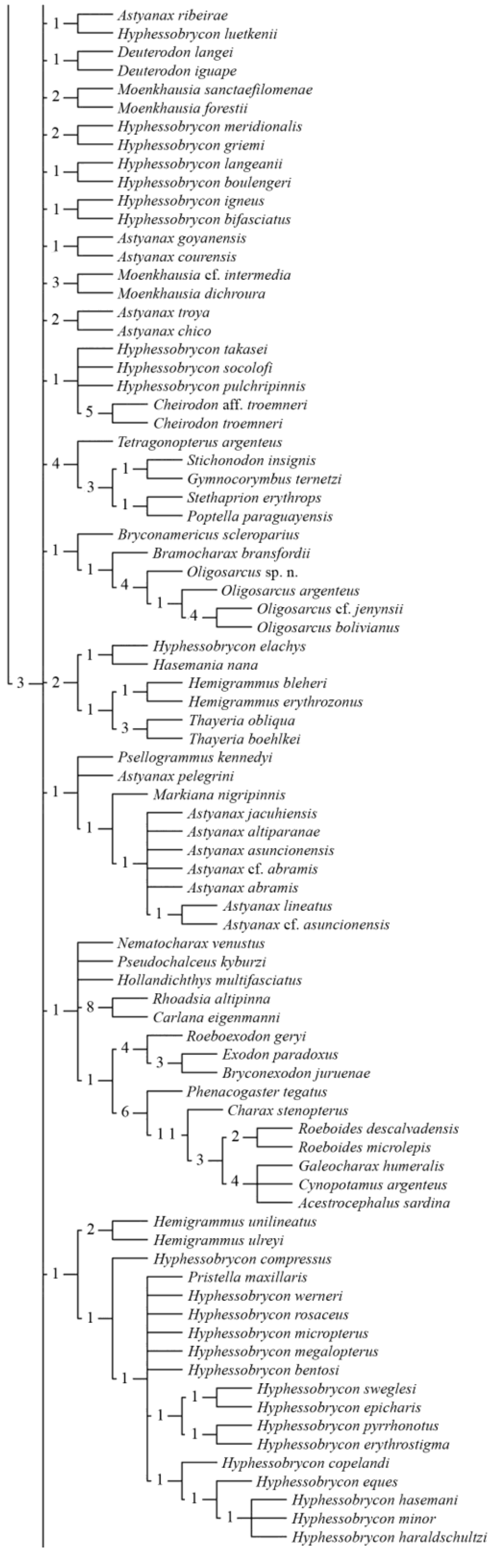

Fig. 9 (cont.). Hypothesis of relationship for the "*A. ribeirae* clade"and outgroup taxa obtained from implied weighted analysis under "k" = 11.51, including absolute Bremer support values in the clades. Based on 122.679 suboptimal trees generated by TBR.

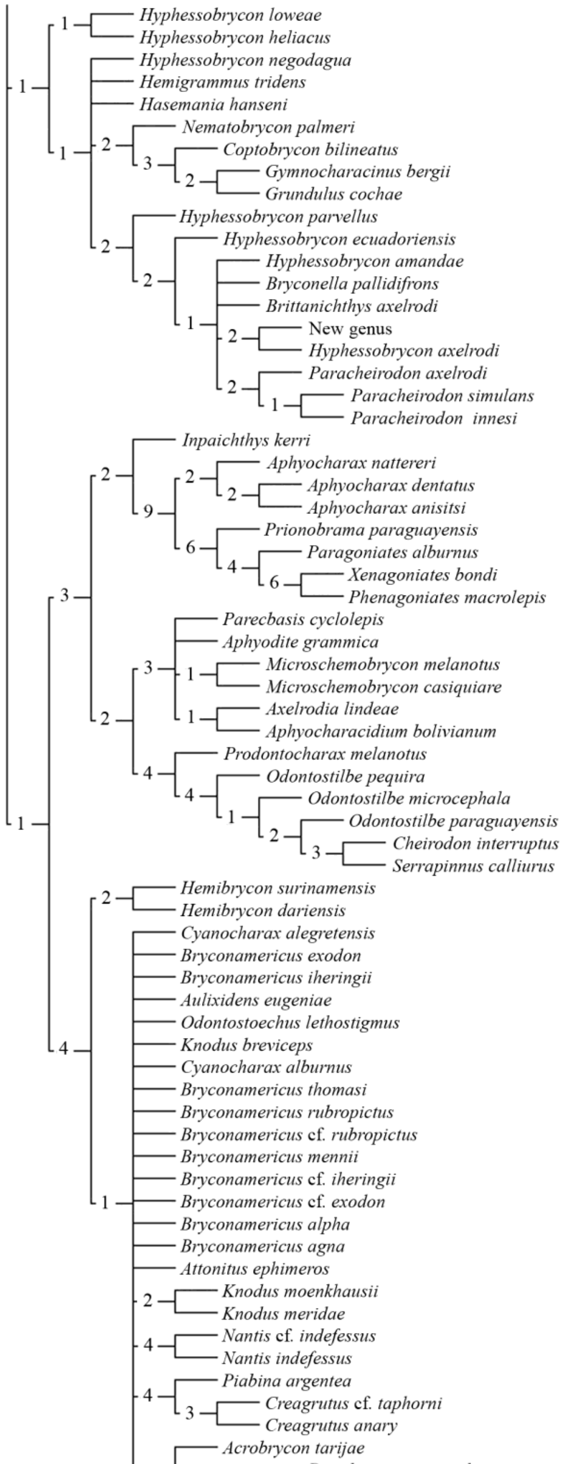

Fig. 9 (cont.). Hypothesis of relationship for the "*A. ribeirae* clade" and outgroup taxa obtained from implied weighted analysis under "k" = 11.51, including absolute Bremer support values in the clades. Based on 122.679 suboptimal trees generated by TBR.

Appendix I. Data set of species analyzed in addiction to data set of Mirande (2009, 2010) and Carvalho (2011). Taxa are listed in alphabetic order. Polymorphisms are denoted as “z”, inapplicable data as “-” and, missing data as “?”

Astyanax giton					
00110010-?	0011000100	1001100001	0000100000	00000?1100	0110000000
00010000?1	-001000000	0010000110	01-1000011	0010000001	1000000100
010001?010	0001100110	001-000000	1110000000	0010000101	0001000110
0101000101	0001100000	0011000010	010100010?	0100010100	1000000000
0000000001	0011000100	00011z0001	1100010001	0100111000	0000010101
0000101100	1100000011	2000000010	0001?1000?	10000?000?	0??0?000??
11000					
Astyanax hastatus					
00110010-?	0011000100	0001100001	0000100000	00000?1100	0110000000
00010000?1	-001000000	0010000110	01-1000010	0010100001	1000000100
010011?010	0001100110	001-000010	0110000000	0000000200	0001000110
0101000101	0001100000	0011000010	0100000101	0100010100	1000000000
0000000001	0001000100	0001110001	1100010001	0100111000	0000010101
000010????	??????0011	2000000010	0001?1000?	10000?000?	0??0?000??
11000					
Astyanax intermedius					
00110010-?	0011000100	0001100001	0000100000	00000?1100	0110000000
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010011?110	0001100110	001-000110	0110000000	0010000?01	0001000110
0101000001	0001100000	0011000010	0100000101	0100010100	1000000000
0000000001	0011000100	0001100001	1100010001	0100111000	0000010101
0000101111	1100000011	2000000010	0001?1000?	100000000?	0??0?000??
11000					
Astyanax janeiroensis					
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00010000?1	-00100????	00?000??10	01-?????1?	??????????	???????100
010011?010	0001z00110	001-0001??	??10??????	???0?????1	???10?????
??????????	??????????	??????????	??????????	?????10100	1000000???
??????????	????00010?	????1??001	11?0010000	010011?000	000?010101
0000101110	0000000011	20?00000??	????????0?	1100000???	0??0?0?0??
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Astyanax jenynsii					
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01010000?1	-???????0?	????????10	0???????1?	??????????	???????100
01??1???10	0001??????	?01-000???	??10??????	??10??????	???1??????
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Astyanax parahybae					
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0101000101 0001100000 0011000010 0100000001 0100010100 1001000000
0000000001 0101000100 0001110001 1100010001 0100111000 0000010101
0000101111 1100000011 2000000010 0001?10000 100000000? 0??00000??
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Astyanax taeniatus
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0001000011 -00100???? 00?000?110 01-?000?1? ?0???????? ???????100
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0100111010 0001110110 001-000000 1010000000 0z00000101 0001000110
0101z00001 0001100000 0011000010 0100000101 0100010100 100z000000
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0000100--- ------0011 2000000010 0001110000 100000000? 0??0?000??
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Deuterodon langei
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0101000001 0001100000 0011000010 0100000101 0100010100 1001000000
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0000100--- ------0011 2000000010 0001?10000 100000000? 0??0?0?0??
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Deuterodon rosae
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0100111010 0001110110 001-000010 1110000000 0100000101 0001000110
0101000001 0001100000 0011000010 0100000101 0100010100 1001000000

0000000001 0101000100 0001110001 1000010001 0100111000 0000010101
0000100--- ------0011 2000000010 0?01???000 10000?000? 0??0?0?0??
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Deuterodon singularis

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0100111010 0001100110 001-000010 1010000000 0000000101 0001000110
0101000101 0001100000 0011000010 0100000101 0100010100 1000000000
0000000001 0101000100 0001110001 1100010001 0100111000 0000010101
0000100--- ------0011 2000000010 0001?10000 100000000? 0??0?0?0??
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Deuterodon stigmaturus

00110010-1 0011000100 0001100001 0000100001 0000011100 0110000000
0001000011 -011-00000 0010000110 01-0011010 0010001001 1000000100
0100111010 0001110110 001-000010 1010000000 0000000101 0001000110
0101000001 0001100000 0011000010 0100000101 0100010100 1001000000
0000000001 0101000100 0001110001 1100010001 0100111000 0000010101
0000100--- ------0011 2000000010 0001?1?000 10000?000? 0??0?0?0??
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Deuterodon supparis

00110010-1 0011000100 0001100001 0000100001 0000011100 0110000000
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0100111010 0001110110 001-000010 0010000000 0000000101 0001000110
0101000?01 0001100000 0011000010 0100000101 0100010100 1001000000
0000000001 0101000100 0001110001 1000010001 0100111000 0000010101
0000100--- ------0011 2000000010 0001???000 10000?000? 0??0?0?0??
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Hyphessobrycon luetkenii

00110010-1 0011000z00 0001100001 0000100z01 0000011z00 0100000000
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0101000001 0001100000 0011000010 0100000001 0100010100 100z000000
0000000001 0101000100 0001110001 1100010001 0100111000 0000010101
0000101111 1100000011 2000000010 0001z10000 100000000? 0??00000??
11000

Appendix II. List of characters including number of steps, and consistency and retention indices of each character in the final hypothesis herein proposed under implied weighting.

Phylogenetic characters

Neurocranium

Epiphyseal bar

1. (4 steps, ci = 13, ri = 25) Posterior laminar expansion of epiphyseal bar: (0) absent; (1) present.

Basioccipital

2. (5 steps, ci = 20, ri = 85) Ventral longitudinal ridges of basioccipital: (0) not reaching posterior border of basioccipital; (1) reaching posterior border of cranium.

Lagenar capsule

3. (9 steps, ci = 11, ri = 75) Ventral projection of lagenar capsule: (0) not projected ventrally to horizontal through articulation between basioccipital and parasphenoid; (1) extending ventrally to articulation between basioccipital and parasphenoid.

4. (1step) Epioccipital bridge over posttemporal fossa: (0) absent; (1) present.

5. (2 steps, ci = 50, ri = 80) Form of epioccipital bridge: (0) cylindrical or vertically expanded in transverse section; (1) depressed.

6. (2 steps, ci = 50, ri = 66) Anterior articulation of epioccipital bridge: (0) with parietal and pterotic; (1) only with parietal.

7. (5 steps, ci = 20, ri = 55) Epioccipital spine, posteriorly orientated: (0) present; (1) absent.

8. (8 steps, ci = 12, ri = 56) Ventromedial opening of posttemporal fossa: (0) absent; (1) present.

9. (3 steps, ci = 33, ri = 66) Position of ventromedial opening of posttemporal fossa: (0) between epioccipital and exoccipital; (1) bordered entirely by epioccipital.

Sphenotic

10. (12 steps, ci = 8, ri = 80) Length of sphenotic spine: (0) not extended ventrally to articulation between sphenotic and hyomandibular; (1) projected ventrally to articulation between sphenotic and hyomandibular.

11. (6 steps, ci = 16, ri = 54) Position of sphenotic spine relative to hyomandibular: (0) aligned with anterior margin of hyomandibular; (1) displaced anteriorly relative to anterior margin of hyomandibular.

12. (7 steps, ci = 14, ri = 45) Position of sphenotic spine relative to orbit: (0) bordering orbit posteriorly, aligned with anterior border of fourth and fifth infraorbitals; (1) conspicuously posterior to orbital margin.

13. (6 steps, ci = 16, ri = 16) Temporal fossa: (0) well developed; (1) absent or much reduced.

Lateral ethmoid

14. (6 steps, ci = 16, ri = 70) Form of anterior process of lateral ethmoid: (0) broad in ventral view, contacting proximal region of vomer in its entire length; (1) slender, leaving a space with vomer.

15. (7 steps, ci = 14, ri = 25) Lateral opening between ventral diverging lamellae of mesethmoid and anterior process of lateral ethmoid: (0) broad; (1) small and ovate, partially occluded by diverging lamellae of mesethmoid and anterior process of lateral ethmoid.

16. (8 steps, ci = 12, ri = 86) Dorsal margin of lateral ethmoids: (0) aligned; (1) situated obliquely in dorsal view, converging in an anteriorly directed angle.

17. (2 steps, ci = 50, ri = 87) Articulation between medial region of lateral ethmoid and frontal or mesethmoid: (0) absent; (1) extensive articulation of entire lateral ethmoid dorsal margin.

Exoccipital

18. (3 steps, ci = 33, ri = 80) Subtemporal fossa: (0) medially extended to middle exoccipital; (1) restricted to pterotic.

State 0&1 to *A. luetkenii vs*. state 0 in Mirande (2010).

19. (1 step) Ascending process on postero-dorsal angle of exoccipital, directed to neural complex of Weberian apparatus: (0) absent; (1) present.

Frontal

20. (2 steps, ci = 50, ri = 50) Anterior extension of frontal: (0) reaching posterior margin of nasal opening; (1) extended between nasals, reaching middle length of nasal opening.

21. (41 steps, ci = 2, ri = 49) Contact between frontals anteriorly to frontal fontanel: (0) absent; (1) present.

State 0 to *D. langei vs*. state 1 in Mirande (2010).

22. (6 steps, ci = 16, ri = 44) Frontal fontanel: (0) present; (1) totally occluded by frontals.

23. (14 steps, ci = 7, ri = 60) Relative size of frontal and parietal fontanels: (0) length of frontal fontanel up to 2⁄3 length of parietal fontanel; (1) length of frontal fontanel 3⁄4 or more than length of parietal fontanel.

24. (2 steps, ci = 50, ri = 60) Dilator fossa on lateral surface of frontal, where dilator opercula muscle attaches: (0) absent, dilator operculi inserts ventrally to frontal; (1) present.

Mesethmoid

25. (3 steps, ci = 33, ri = 66) Anterior end of mesethmoid: (0) trifurcate, with processes directed to depressions on premaxillae; (1) not trifurcate, with a triangular anterior spine and articular processes reduced or absent.

26. (2 steps, ci = 50, ri = 66) Ventral projection of mesethmoid spine, forming a keel between premaxillae: (0) absent; (1) present.

27. (5 steps, ci = 20, ri = 78) Form of mesethmoid spine: (0) slender in dorsal view, developed between premaxilllae; (1) broad in dorsal view and relatively short, with premaxillae articulating each other anteriorly to mesethmoid.

28. (1 step, ci = 100, ri = 100) Posterior region of mesethmoid spine: (0) relatively slender; (1) as broad as lateral wings of mesethmoid.

29. (2 steps, ci = 50, ri = 50) Lateral wings of mesethmoid: (0) present; (1) absent.

30. (2 steps, ci = 50, ri = 94) Ventral diverging lamellae of mesethmoid: (0) absent; (1) present.

31. (10 steps, ci = 10, ri = 65) Anterior convergence of ventral diverging lamellae with nasal septum of mesethmoid: (0) absent, or confluent near anterior end of nasal septum; (1) confluent at posterior end of nasal septum.

32. (1 step, ci = 100, ri = 100) Nasal septum of mesethmoid: (0) a single longitudinal lamella; (1) two parallel lamellae apparently formed, in part, by ventral diverging lamellae.

Nasal

33. (5 steps, ci = 20, ri = 20) Nasal: (0) present; (1) absent.

34. (5 steps, ci = 20, ri = 33) Bony lamellae bordering sensory canal of nasal: (0) absent or more slender than tubular region; (1) wider, in some point, than tubular region.

Orbitosphenoid

35. (5 steps, ci = 20, ri = 63) Synchondral articulation between lateral ethmoid and anterodorsal border of orbitosphenoid: (0) present; (1) absent, with orbitosphenoid distant from lateral ethmoid.

36. (6 steps, ci = 50 , ri = 72) Lateral bony covering of olfactory nerve: (0) absent; (1) covered by a posterior expansion of lateral ethmoid; (2) covered by an anterior tubular projection of orbitosphenoid; (3) covered lateral and inferiorly by orbitosphenoid and lateral ethmoid, which are not forming a canal.

37. (8 steps, ci = 12, ri = 74) Form of orbitosphenoid: (0) slender and relatively small, separated from parasphenoid; (1) massive, almost reaching parasphenoid ventrally.

38. (20 steps, ci = 5, ri = 65) Distance between cartilage anterior to orbitosphenoid and lateral ethmoids: (0) contacting, or almost contacting lateral ethmoids; (1) distant from lateral ethmoids.

State 0&1 to *A. luetkenii vs*. state 1 in Mirande (2010).

39. (4 steps, ci = 25, ri = 50) Opening between orbitosphenoid, pterosphenoid, and frontal: (0) present, rounded or ovate; (1) absent.

Parasphenoid

40. (18 steps, ci = 5, ri = 68) Anterior paired projections of parasphenoid: (0) absent; (1) present.

State 1 to *A. luetkenii vs*. state 0 in Mirande (2010).

Parietal

41. (6 steps, ci = 16, ri = 37) Parietal fontanel: (0) present in adults; (1) completely occluded by parietals.

Prootic

42. (1 step, ci = 100, ri = 100) Trigemino-facialis foramen: (0) broad, dorsally limited by sphenotic; (1) narrow, as a cleft almost completely limited by prootic and pterosphenoid.

Pterosphenoid

43. (1 steps, ci = 100, ri = 100) Large foramen on pterosphenoid: (0) absent, only small foramina; (1) present, well developed.

44. (2 steps, ci = 50, ri = 50) Small foramen near posterior margin of pterosphenoid: (0) absent, or not pierced by nerves; (1) present, pierced by a branch of supraorbital nerve.

Pterotic

45. (7 steps, ci = 14, ri = 57) Process of pterotic where fibers from epaxial musculature attaches: (0) absent or ventrally projected from tube for horizontal semicircular canal; (1) dorsally projected from tube for semicircular canal.

46. (3 steps, ci = 33, ri = 94) Relative length of pterotic spine: (0) posteriorly projected from attachment site of hyomandibular ligament; (1) extended only to attachment region of hyomandibular ligament.

Rhinosphenoid

47. (19 steps, ci = 5, ri = 63) Rhinosphenoid: (0) absent or not ossified; (1) present, ossified.

48. (14 steps, ci = 7, ri = 82) Dorsal expansion of rhinosphenoid: (0) absent; (1) present, forming a bony wall between olfactory nerves.

State 0&1 to *A. luetkenii vs*. state 0 in Mirande (2010).

49. (2 steps, ci = 50, ri = 0) Posterior extension of rhinosphenoid cartilage: (0) projected near vertical through middle length of orbitosphenoid; (1) extended only to vertical through region of articulation between orbitosphenoid and pterosphenoid.

50. (2 steps, ci = 50, ri = 75) Ventral border of rhinosphenoid: (0) separated from parasphenoid; (1) almost contacting parasphenoid.

Supraoccipital

51. (3 steps, ci = 33, ri = 60) Anterior border of supraoccipital: (0) completely behind vertical through posterior border of the orbit; (1) anterior to vertical through posterior border of the orbit.

52. (15 steps, ci =6, ri = 44) Length of supraoccipital spine: (0) projected dorsal to entire neural complex of Weberian apparatus; (1) projected dorsal to approximately middle length of neural complex.

53. (27 steps, ci = 3, ri = 70) Length of supraoccipital spine: (0) projected dorsal to, at least, middle length of neural complex of Weberian apparatus; (1) projected just to anterior axis of neural complex.

Vomer

54. (5 steps, ci = 20, ri = 33) Dorsolateral processes of vomer: (0) absent; (1) present.

Orbital region

Antorbital

55. (3 steps, ci = 33, ri = 0) Antorbital: (0) present; (1) absent or fused with first infraorbital.

56. (4 steps, ci = 25, ri = 50) Position of antorbital relative to lateral ethmoid: (0) antorbital entirely anterior to lateral ethmoid; (1) antorbital overlapping lateral ethmoid in lateral view.

Infraorbitals

57. (3 steps, ci = 33, ri = 86) Anterior end of antorbital and first infraorbital: (0) anterior margin of antorbital either aligned or anterior than first infraorbital; (1) first infraorbital anteriorly projected relative to antorbital.

58. (4 steps, ci = 25, ri = 86) Bony lamellae bordering laterosensory canal of first infraorbital: (0) present; (1) absent on first infraorbital but present on remaining infraorbitals.

59. (5 steps, ci = 20, ri = 33) Expansion of first infraorbital lateral to maxilla: (0) covering less than middle length of maxilla; (1) covering laterally most of maxillary length.

60. (2 steps, ci = 50, ri = 75) Overlapping of first infraorbital by anterior margin of second infraorbital: (0) absent; (1) present.

61. (7 steps, ci = 14, ri = 62) Overlapping of maxilla by second infraorbital: (0) absent; (1) present.

62. (38 steps, ci = 5, ri = 64) Articulation between second and third infraorbitals: (0) vertical; (1) antero-ventrally oblique; (2) postero-ventrally oblique.

63. (7 steps, ci = 15, ri = 53) Anterior region of third infraorbital: (0) not much expanded relative to posterior region of second infraorbital; (1) abruptly expanded relative to posterior region of second infraorbital.

64. (35 steps, ci = 2, ri = 54) Ventral covering of third infraorbital: (0) reaching horizontal arm of preopercle; (1) not reaching horizontal arm of preopercle, at least anteriorly.

65. (4 steps, ci = 25, ri = 0) Posterior extension of third infraorbital: (0) covering angle of preopercle; (1) relatively reduced, with angle of preopercle covered partially by fourth infraorbital.

66. (16 steps, ci = 6, ri = 51) Fourth infraorbital: (0) present, well developed; (1) absent, fused with fifth infraorbital, or reduced and bordered posteriorly by third and fifth infraorbitals.

67. (32 steps, ci = 3, ri = 65) Form of fourth infraorbital: (0) approximately squared or more developed longitudinally than dorsoventrally; (1) longer dorsoventrally than longitudinally.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010).

68. (3 steps, ci = 33, ri = 66) Posterior dorsoventral expansion of fourth infraorbital: (0) absent; (1) fourth infraorbital expanded between fifth infraorbital and preopercle.

State 0 to *D. iguape* and *A. luetkenii vs*. missing data (?) and inapplicable data (-) in Mirande (2010).

69. (16 steps, ci = 6, ri = 79) Lateral covering of dilator fossa by sixth infraorbital: (0) almost complete, at least in its ventral border; (1) leaving a conspicuous naked area in anterior region of dilator fossa.

State 1 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010).

Supraorbital

70. (5 steps, ci = 20, ri = 87) Supraorbital: (0) present; (1) absent.

71. (5 steps, ci = 20, ri = 69) Contact between supraorbital and sixth infraorbital: (0) absent; (1) present.

Laterosensory system

Infraorbital canal

72. (8 steps, ci = 12, ri = 36) Laterosensory canal in antorbital: (0) absent; (1) present.

73. (14 steps, ci = 7, ri = 55) Laterosensory canal of first infraorbital: (0) projected dorsally from main body of first infraorbital; (1) absent or not projected dorsally.

State 0 to *D. iguape* and *D. langei vs*. state 1 in Mirande (2010).

74. (14 steps, ci = 7, ri = 65) Branching of laterosensory canals of fourth or fifth infraorbitals: (0) reduced or absent; (1) present, conspicuous.

State 1 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010).

75. (2 steps, ci = 50, ri = 0) Direction of posterior branch of laterosensory canal of fourth or fifth infraorbital: (0) to a pore on preopercle near hyomandibular condyle; (1) to a pore conspicuously ventral to hyomandibular condyle.

76. (17 steps, ci = 5, ri = 48) Laterosensory canal of sixth infraorbital: (0) not branched; (1) branched.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010).

77. (9 steps, ci = 11, ri = 50) Position of opening on neurocranium for laterosensory canal from sixth infraorbital: (0) between frontal and pterotic; (1) in frontal.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010).

78. (1 step, ci = 100, ri = 100) Relative position of opening in neurocranium receiving sixth infraorbital laterosensory canal: (0) lateral or slightly anterior to sphenotic tube for vertical semicircular canal; (1) conspicuously anterior to sphenotic tube for vertical semicircular canal.

Dentary-preopercle canal

79. (11 steps, ci = 9, ri = 33) Extension of laterosensory canal of dentary: (0) piercing almost entire length of dentary; (1) reduced or absent.

State 0 to *A. luetkenii vs*. state 1 in Mirande (2010).

80. (3 steps, ci = 33, ri = 77) Pores of laterosensory canal of lower jaw: (0) six or less; (1) seven or more.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010).

81. (9 steps, ci = 11, ri = 70) Lateral covering of vertical canal of preopercle: (0) by musculature and/or infraorbitals; (1) absent, canal situated posteriorly to musculature and infraorbitals.

82. (9 steps, ci = 11, ri = 50) Dorsal end of laterosensory canal of preopercle: (0) not overlapping anterodorsal projection of opercle; (1) overlapping, in lateral view, anterodorsal corner of opercle.

Frontoparietal canal

83. (3 steps, ci = 33, ri = 92) Anterior region of laterosensory canal of frontal: (0) contained completely by frontal to its anterior opening; (1) open in a chamber limited dorsally by frontal, and ventrally by lateral ethmoid.

84. (4 steps, ci = 25, ri = 88) Epiphyseal branch of frontoparietal laterosensory canal: (0) present; (1) absent.

85. (2 steps, ci = 50, ri = 50) Epiphyseal laterosensory canals: (0) both aligned with epiphyseal bar; (1) orientated obliquely, opening posteriorly to epiphyseal bar.

86. (3 steps, ci = 33, ri = 50) Opening of epiphyseal laterosensory canals: (0) at margin of cranial fontanel; (1) canals extended dorsomedially by soft tissue, opening over the cranial fontanel.

87. (1 step, ci = 100, ri = 100) Laterosensory canal on sphenotic: (0) absent; (1) present.

Posttemporal canal

88. (5 steps, ci = 20, ri = 84) Posterior branch of posttemporal laterosensory canal: (0) present; (1) absent.

Lateral line

89. (3 steps, ci = 33, ri = 77) Curvature of lateral line: (0) approximately straight; (1) curve in abdominal region.

90. (3 steps, ci = 33 , ri = 50) Curvature of lateral line: (0) straight or not much curved, with posterior region orientated to middle caudal-fin rays; (1) much curved and ventrally situated, with posterior region running by ventral half of caudal peduncle and orientated to inferior lobe of caudal fin.

91. (25 steps, ci = 4, ri = 75) Lateral line: (0) complete; (1) interrupted.

92. (23 steps, ci = 4, ri = 77) Canal of lateral line on caudal-fin membrane: (0) absent; (1) present.

State1 to *A. luetkenii vs*. state 0 in Mirande (2010).

93. (6 steps, ci = 16, ri = 60) Length of caudal-fin canal of lateral line: (0) reaching only half of caudal-fin length; (1) almost reaching posterior margin of caudal fin.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010). This character was considerable innaplicabe for species with incomplete lateral line in Mirande(2010).

Upper jaw

Maxilla

94. (4 steps, ci = 25, ri = 50) Anterior end of ascending process of maxilla: (0) with a conspicuous notch; (1) pointed or rounded.

95. (1 step, ci = 100, ri = 100) Ventral margin of toothed region of maxilla: (0) roughly straight; (1) strongly concave.

96. (7 steps, ci = 14, ri = 66) Margins of toothed region of maxilla: (0) roughly parallel; (1) dorsally divergent.

97. (3 steps, ci = 33, ri = 80) Expansion of lamellar portion of maxilla just posterior to toothed region: (0) absent or not pronounced; (1) much pronounced.

State 0&1 to *D. iguape vs*. state 0 in Mirande (2010).

98. (11 steps, ci = 18 , ri = 84) Tubules for passage of blood vessels on lamellar portion of maxilla: (0) a single tubule, parallel to dorsal margin of maxilla; (1) with an anterior branch, parallel to anterior margin of maxilla, reaching one third of its length; (2) anastomosed tubules.

99. (2 steps, ci = 50, ri = 85) Length of maxilla relative to infraorbitals: (0) not reaching second infraorbital; (1) extended to second infraorbital.

100. (14 steps, ci = 7, ri = 60) Length of maxilla relative to dentary: (0) maxilla reaching posterior end of Meckelian cartilage; (1) maxilla not reaching posterior end of Meckelian cartilage.

101. (1 step, ci = 100, ri = 100) Ontogenetic lengthening of maxilla: (0) absent; (1) present.

102. (1 step, ci = 100, ri = 100) Dorsal projection of maxilla lateral to second infraorbital: (0) absent; (1) present when mouth is closed, covering lateral surface of second infraorbital.

Premaxilla

103. (6 steps, ci = 16, ri = 58) Interdigitations between premaxillae: (0) present; (1) absent.

104. (29 steps, ci = 3, ri = 70) Length of ascending process of premaxilla: (0) reaching at least one-third of nasal length; (1) reaching just anterior end of nasal.

State 0 to *A. luetkenii vs*. state 1 in Mirande (2010).

105. (3 steps, ci = 33, ri = 75) Alignment of ascending process of premaxilla: (0) aligned with medial margin of nasal; (1) medially displaced, separated from nasal.

106. (1 step, ci = 100, ri = 100) Form of posterolateral portion of premaxilla: (0) with a notch; (1) with a pedicle expanded laterally to maxilla.

Lower jaw

Anguloarticular

107. (8 steps, ci = 12, ri = 46) Lateral ridge of anguloarticular: (0) absent; (1) present.

108. (7 steps, ci = 14, ri = 81) Horizontal process of anguloarticular: (0) covered laterally by dentary only at anterior end; (1) covered extensively by dentary, which reaches posterior border of Meckelian cartilage.

109. (18 steps, ci = 5, ri = 71) Ventral margin of horizontal process of anguloarticular: (0) posteroventrally oblique to laterosensory canal of dentary in medial view; (1) perpendicular to laterosensory canal of dentary.

Coronomeckelian

110. (23 steps, ci = 4, ri = 72) Dorsoventral position of coronomeckelian: (0) mainly lateral to Meckelian cartilage; (1) mainly dorsal to Meckelian cartilage.

Dentary

111. (1 step, ci = 100, ri = 100) Interdigitations between dentaries: (0) absent; (1) present.

112. (2 steps, ci = 50, ri = 66) Form of interdigitations between dentaries: (0) simple bony lamellae; (1) undulate lamellae.

113. (1 step, ci = 100, ri = 100) Form and dentition of anterior end of dentary: (0) toothed and not depressed anteriorly; (1) edentulous and much depressed anteriorly.

114. (2 steps, ci = 50, ri = 50) Anteroventral notch of dentary: (0) absent; (1) present.

115. (1 step, ci = 100, ri = 100) Medial process of dentary bordering Meckelian cartilage dorsal and medially: (0) absent; (1) present.

116. (1 step, ci = 100, ri = 100) Bony lamella covering dentary foramen laterally: (0) absent; (1) present.

117. (1 step, ci = 100, ri = 100) Longitudinal ridge covering laterosensory pores of dentary: (0) absent; (1) present.

Dentition

Generalities

118. (8 steps, ci = 12, ri = 61) Morphology of premaxillary, maxillary, and dentary teeth: (0) all teeth conical, caniniform or mamiliform; (1) some teeth multicuspidate or molariform.

119. (3 steps, ci = 33, ri = 66) Premaxillary, maxillary, and dentary teeth: (0) absent, or pedunculate only in some of these bones; (1) pedunculate and uniformly shaped.

Premaxillary teeth

120. (3 steps, ci = 33, ri = 60) Mamilliform teeth outside the mouth: (0) absent; (1) present.

121. (4 steps, ci = 25, ri = 62) A pair of conical teeth in premaxilla with smaller teeth in middle: (0) absent; (1) present.

122. (13 steps, ci = 7, ri = 63) Number of premaxillary rows of teeth: (0) one; (1) two or three.

123. (4 steps, ci = 25, ri = 66) Number of premaxillary rows of teeth: (0) one or two; (1) three.

Outer row of premaxillary teeth

124. (2 steps, ci = 50, ri = 50) Alignment of teeth on the outer premaxillary row: (0) aligned; (1) not aligned, with one or two teeth situated anteriorly to remaining ones.

125. (13 steps, ci = 7, ri = 60) Cusps of teeth on the outer premaxillary row: (0) one to three cusps; (1) five or more cusps.

Inner row of premaxillary teeth

126. (3 steps, ci = 66, ri = 75) Teeth in the inner premaxillary row: (0) molariform; (1) with aligned or curvedly disposed cusps; (2) with curvedly disposed cusps plus an anterior cusp.

127. (7 steps, ci = 14, ri = 68) Alignment of cusps of medial in the inner premaxillary row: (0) forming a semicircle anteriorly concave in ventral view; (1) forming a shallow arch or aligned in ventral view.

128. (8 steps, ci = 12, ri = 66) Form of teeth from posterior premaxillary row: (0) with cusps forming an anteriorly orientated arch; (1) with aligned cusps, without an anterior concavity.

129. (14 steps, ci = 7, ri = 62) Number of teeth in the inner premaxillary row: (0) four or less; (1) five or more.

130. (12 steps, ci = 8, ri = 38) Number of teeth in the inner premaxillary row: (0) seven or less; (1) eight or more.

131. (2 steps, ci = 50, ri = 83) Polymorphism of teeth from posterior premaxillary row: (0) absent; (1) present, with two medial teeth somewhat larger and usually separated from remaining ones by a gap.

132. (2 steps, ci = 50, ri = 50) Number of replacement teeth rows on premaxilla: (0) one; (1) two or more.

133. (5 steps, ci = 20, ri = 63) Fossa for inner row of premaxillary replacement teeth: (0) absent; (1) present.

Maxillary teeth

134. (18 steps, ci = 5, ri = 46) Maxillary teeth: (0) absent; (1) present.

135. (23 steps, ci = 4, ri = 60) Number of maxillary teeth: (0) only one, or absent; (1) two or more.

136. (6 steps, ci = 16, ri = 58) Number of maxillary teeth: (0) up to three; (1) four or more.

State 1 to *D. iguape vs*. state 0 in Mirande (2010).

137. (15 steps, ci = 6, ri = 64) Extension of maxillary teeth: (0) not reaching half maxillary lamella; (1) reaching almost entire maxillary lamella.

138. (15 steps, ci = 6, ri = 58) Number of cusps of anterior maxillary teeth: (0) conical, a single cusp; (1) three or more cusps.

139. (30 steps, ci = 3, ri = 53) Number of cusps of anterior maxillary teeth: (0) up to three; (1) five or more cusps.

140. (1 step, ci = 100, ri = 100) Ontogenetic growth of conical teeth on maxilla: (0) absent; (1) present.

Dentary teeth

141. (3 steps, ci = 33, ri = 33) Orientation of anterior dentary teeth: (0) orientated dorsal or anterodorsally; (1) orientated anteriorly, almost parallel to main axis of dentary.

142. (6 steps, ci = 16, ri = 54) Size and number of anterior dentary teeth: (0) four or five relatively broad teeth in front of dentary; (1) eight or more small and slender teeth in front of dentary.

143. (12 steps, ci = 8, ri = 59) Inner row of dentary teeth: (0) present; (1) absent.

144. (3 steps, ci = 33, ri = 83) Symphyseal dentary teeth: (0) absent; (1) present.

145. (1 step, ci = 100, ri = 100) Articulation between dentary teeth: (0) absent; (1) present, with processes and fossae.

146. (1 step) Position of dentary anterior teeth: (0) in margin of dentary; (1) internally displaced, with dentary forming an anterior ridge.

147. (3 steps, ci = 33, ri = 60) Separation between posterior dentary teeth: (0) less than width of these teeth; (1) more than width of these teeth.

148. (23 steps, ci = 4, ri = 43) Abrupt decrease in size of dentary teeth: (0) absent; (1) present.

Suspensorium

Quadrate

149. (14 steps, CI = 7, RI = 48) Foramen on articular condyle of quadrate: (0) absent; (1) present.

150. (9 steps, ci = 11, ri = 57) Form of quadrate: (0) with ventral portion longer than anterodorsal one; (1) with anterodorsal portion equal or longer than ventral one.

151. (32 steps, ci = 3, ri = 59) Posterior extension of ventral process of quadrate: (0) reaching vertical through posterior margin of symplectic; (1) not reaching this margin.

State 1 to *D. iguape* and *D. langei vs.*state 0 in Mirande (2010).

152. (7 steps, ci = 14, ri = 53) Longitudinal ridge in quadrate bordering *adductor mandibulae* muscle ventrally and, to some degree laterally: (0) absent; (1) present.

State 1 to *A. luetkenii vs.*state 0 in Mirande (2010).

153. (3 steps, ci = 33, ri = 71) Articulation between quadrate and anguloarticular: (0) anterior or at vertical through lateral ethmoid; (1) posterior to lateral ethmoid.

154. (9 steps, ci = 11, ri = 63) Articulation between quadrate and anguloarticular: (0) anterior or at vertical through middle eye; (1) posterior to middle of eye.

155. (10 steps, ci = 10, ri = 50) Articulation between ventral margin of metapterygoid and posterodorsal margin of quadrate: (0) absent; (1) present.

Ectopterygoid

156. (3 steps, ci = 66, ri = 0) Form of ectopterygoid: (0) elongated; (1) triangular, much broadened anteriorly; (2) approximately square.

157. (5 steps, ci = 20, ri = 55) Form of anterior tip of ectopterygoid: (0) broad, articulating extensively with palatine and connected to neurocranium by ligaments; (1) slender, articulating only tolateralmargin ofpalatine, andlacking ligaments to neurocranium.

158. (1 step, ci = 100, ri = 100) Dorsal process of ectopterygoid orientated to lateral ethmoid: (0) absent; (1) present.

159. (8 steps, ci = 12, ri = 36) Ectopterygoid teeth row: (0) absent; (1) present.

160. (2 steps, ci = 50, ri = 0) Patch of ectopterygoid teeth: (0) absent; (1) present.

161. (6 steps, ci = 16, ri = 54) Position of longitudinal cartilage dorsal to ectopterygoid: (0) limited medially by endopterygoid; (1) displaced laterally, separated from medial margin of endopterygoid.

162. (12 steps, ci = 8, ri = 68) Contact between ectopterygoid and anterodorsal region of quadrate: (0) present; (1) absent.

State 1 to *D. langei vs.*state 0 in Mirande (2010).

Interopercle

163. (17 steps, ci = 5, ri = 42) Anterior extension of interopercle: (0) surpassing horizontal arm of preopercle; (1) not surpassing horizontal arm of preopercle.

164. (6 steps, ci = 16, ri = 54) Posterior expansion of interopercle: (0) absent; (1) present, abrupt.

Mesopterygoid

165. (2 steps, ci = 50, ri = 50) Metapterygoid teeth: (0) absent; (1) present.

Metapterygoid

166. (1 step, ci = 100, ri = 100) Anterodorsal lobe of metapterygoid orientated to endopterygoid: (0) absent, or reduced and orientated dorsally; (1) present, conspicuous and orientated anteriorly.

167. (1 step, ci = 100, ri = 100) Form of metapterygoid-quadrate fenestra: (0) rounded or ovate, anteriorly limited by anterodorsal region of quadrate; (1) anteriorly collapsed by convergence of metapterygoid and ventral region of quadrate.

168. (18 steps, ci = 11, ri = 73) Foramen in posterior region of metapterygoid: (0) absent; (1) present, contained by metapterygoid or limited partially by a cartilage; (2) an incomplete arch, limited posteriorly by hyomandibular.

Opercle

169. (2 steps, ci = 50, ri = 66) Posteriorly directed radial striae from articular region of opercle: (0) absent; (1) present.

170. (27 steps, ci = 3, ri = 27) Length of medial bony ridge of opercle: (0) 60% or more than opercular length; (1) less than half opercular length.

Palatine

171. (15 steps, ci = 6, ri = 50) Ethmopalatine cartilage: (0) absent or reduced in size; (1) present, conspicuous.

172. (21 steps, ci = 4, ri = 68) Relative length of palatine: (0) approximately half length of ectopterygoid, or less; (1) longer than half length of ectopterygoid.

173. (3 steps, ci = 33, ri = 33) Palatine foramen: (0) absent or reduced in size; (1) present, very conspicuous.

Preopercle

174. (1 step, ci = 100, ri = 100) Form of posteroventral corner of propercle: (0) acute; (1) rounded.

Suprapreopercle

175. (7 steps, ci = 14, ri = 45) Suprapreopercle: (0) fused to preopercle; (1) autogenous, separated from preopercle.

176. (2 steps, ci = 50, ri = 75) Bony lamellae bordering laterosensory canal of suprapreopercle: (0) absent; (1) present.

Branchial and hyoid arches

Anterior ceratohyal

177. (1 step, ci = 100, ri = 100) Anterior projection of anterior ceratohyal, articulating laterally with hypohyals: (0) absent or much reduced; (1) present, reaching half length of hypohyals.

178. (1 step, ci = 100, ri = 100) Hyoid artery: (0) contained completely within anterior ceratohyal in its passage from posterior ceratohyal to hypohyals; (1) emerging from anterior ceratohyal near its articulation with posterior ceratohyal.

179. (7 steps, ci = 14, ri = 77) Posterior margin of anterior ceratohyal: (0) smooth, without notches; (1) with notches for articulation of branchiostegal rays.

180. (2 steps, ci = 50, ri = 75) Notches in posterior margin of anterior ceratohyal: (0) absent, or two, corresponding with anterior two branchiostegal rays; (1) with a third notch, for third branchiostegal ray.

181. (4 steps, ci = 25, ri = 40) Articulation between ceratohyals: (0) synchondral, without bony interdigitations; (1) with bony interdigitations between anterior and posterior ceratohyals.

Basibranchials

182. (2 steps, ci = 50, ri = 83) First basibranchial: (0) absent or much reduced, not articulating anteriorly with basihyal; (1) developed, articulating anteriorly with basihyal.

183. (10 steps, ci = 10, ri = 52) Contact between first and second basibranchials: (0) absent; (1) present, through dorsal bony lamellae.

184. (19 steps, ci = 5, ri = 28) Bony lamellae dorsal to second and third basibranchials: (0) absent; (1) present.

185. (19 steps, ci = 5, ri = 66) Bony lamella dorsal to fourth basibranchial: (0) present; (1) absent.

186. (1 step, ci = 100, ri = 100) Fourth basibranchial: (0) completely cartilaginous; (1) ossified.

187. (2 steps, ci = 50, ri = 0) Teeth on lamella dorsal to fourth basibranchial: (0) absent; (1) present.

Basihyal

188. (23 steps, ci = 4, ri = 26) Cartilages anterior to basihyal: (0) one block of cartilage, or two, but anterior one much reduced; (1) two well developed blocks of cartilage.

State 0 to *D. iguape vs*. missing data (?) in Mirande (2010).

189. (8 steps, ci = 12, ri = 70) Edentulous basihyal plate: (0) absent; (1) present.

190. (2 steps, ci = 50, ri = 66) Anterior development of basihyal: (0) broadly surpassing anterior margin of hypohyals; (1) reduced, slightly surpassing this margin.

191. (7 steps, ci = 14, ri = 25) Anterior expansion of basihyal: (0) slender, with anterior margin much reduced relative to its length; (1) expanded, with anterior margin with approximately two thirds of its length.

Gill rakers

192. (20 steps, ci = 5, ri = 53) Rows of gill rakers on first ceratobranchial: (0) one; (1) two.

193. (24 steps, ci = 4, ri = 63) Rows of gill rakers on second ceratobranchial: (0) one; (1) two.

194. (1 step) Rows of gill rakers on third and fourth ceratobranchials: (0) one; (1) two.

195. (16 steps, ci = 6, ri = 42) Number of gill rakers on first hypobranchial and ceratobranchial: (0) 16 or more; (1) 15 or fewer.

196. (35 steps, ci = 2, ri = 34) Number of gill rakers on first hypobranchial and ceratobranchial: (0) 11 or more; (1) ten or fewer.

197. (3 steps, ci = 66, ri = 75) Form of first ceratobranchial gill rakers: (0) pointed, not anteroposteriorly compressed; (1) laminary, much compressed, perpendicular to ceratobranchial; (2) short, broad and strongly denticulated.

198. (1 step, ci = 100, ri = 100) Form of first ceratobranchial anterior gill rakers: (0) not fused; (1) with fused bases, forming plates extensively articulated withceratobranchial.

199. (6 steps, ci = 20, ri = 73) Lateral base of gill rakers: (0) slender; (1) broad and laminar, at least in anterior most gill rakers.

200. (5 steps, ci = 20, ri = 73) Form and ossification degree of first ceratobranchial gill rakers: (0) laminar, not ossified distal region; (1) rather strong, completely ossified distal region.

201. (16 steps, ci = 6, ri = 60) Denticles on gill rakers: (0) present; (1) absent.

202. (22 steps, ci = 4, ri = 61) Distribution of denticles on gill rakers: (0) restricted to margins, or absent; (1) on entire surface of gill rakers.

State 0 to *D. langei vs.*state 1 in Mirande (2010).

203. (2 steps, ci = 50, ri = 50) Rows of gill rakers on first epibranchial: (0) one; (1) two.

Ceratobranchials

204. (7 steps, ci = 14, ri = 45) Form of fifth ceratobranchial dentigerous plate: (0) rounded, with a posterior notch; (1) elongated, without posterior notch.

205. (1 step, ci = 100, ri = 100) Teeth on fifth ceratobranchial: (0) present; (1) absent.

Pharyngobranchials

206. (7 steps, ci = 14, ri = 40) Teeth on third pharyngobranchial: (0) present; (1) absent.

207. (1 step, ci = 100, ri = 100) Teeth on fourth pharyngobranchial: (0) present; (1) absent.

208. (1 step, ci = 100, ri = 100) Teeth on fifth pharyngobranchial: (0) present; (1) absent.

209. (1 step, ci = 100, ri = 100) Contact between fourth and fifth pharyngobranchial dentigerous plates: (0) absent; (1) present.

Interhyal

210. (2 steps, ci = 50, ri = 0) Interhyal: (0) present; (1) absent.

211. (4 steps, ci = 25, ri = 66) Length of interhyal: (0) shorter than one third of symplectic length; (1) equal or longer than one half of symplectic length.

Branchiostegal rays

212. (2 steps, ci = 20, ri = 0) Number of branchiostegal rays: (0) three; (1) four or five.

213. (2 steps, ci = 20, ri = 0) Number of branchiostegal rays: (0) three or four; (1) five.

214. (4 steps, ci = 28, ri = 70) Anterior end of branchiostegal rays: (0) broadened near their articulation with ceratohyals; (1) slender in this region.

215. (1 step, ci = 100, ri = 100) Attachment of first branchiostegal ray: (0) in proximal third of anterior ceratohyal; (1) in middle of anterior ceratohyal, or posteriorly to this point.

216. (1 step, ci = 100, ri = 100) Distance between attachment site of first and second branchiostegal rays: (0) equal or shorter than distance between second and third ones; (1) longer than distance between second and third branchiostegal rays.

217. (1 step, ci = 100, ri = 100) Number of branchiostegal rays attached to posterior ceratohyal: (0) one; (1) two.

Vertebrae, ribs and Weberian apparatus

Weberian apparatus

218. (3 steps, ci = 33, ri = 53) Form and articulation of neural pedicle of third vertebra: (0) well developed pedicle, articulating synchondrally with neural complex; (1) much reduced, without an articular surface with neural complex.

State 0 to *A. luetkenii vs*. state 1 in Mirande (2010).

219. (13 steps, ci = 7, ri = 36) Development of transverse process of third vertebra neural arch: (0) not reaching anterior margin of tripus; (1) well developed, surpassing anterior margin of tripus.

State 0 to *D. langei vs.*state 1 in Mirande (2010).

220. (3 steps, ci = 33, ri = 83) Ascending process of neural pedicle of third vertebra: (0) absent; (1) present, reaching or not neural complex.

221. (2 steps, ci = 50, ri = 95) Dorsal development of dorsal process of third vertebra neural pedicle: (0) not extensively overlapping neural complex; (1) conspicuously overlapping neural complex.

State 0 to *A. luetkenii vs*. state 0&1 in Mirande (2010).

222. (1 step, ci = 100, ri = 100) Neural arch and vertebral centrum of fourth vertebra: (0) not fused, autogenous fourth neural arch; (1) fused each other.

Ribs

223. (3 steps, ci = 33, ri = 60) Anteriorly directed spine at base of first rib: (0) absent; (1) present.

224. (3 steps, ci = 33, ri = 32) Laminary bony ridge on dorsal margin of abdominal ribs: (0) absent; (1) present.

225. (1 step, ci = 100, ri = 100) Abdominal ribs on anterior caudal vertebrae: (0) absent; (1) present, associated to first and occasionally second caudal vertebrae.

Vertebrae

226. (7 steps, ci = 14, ri = 66) Proportion of precaudal and caudal vertebrae: (0) two or more precaudal than caudal vertebrae; (1) equal or more caudal than precaudal vertebrae.

227. (9 steps, ci = 11, ri = 52) Number of vertebrae: (0) 40 or less; (1) 41 or more.

228. (9 steps, ci = 11, ri = 66) Total number of transitional vertebrae: (0) four or more; (1) three or fewer.

229. (21 steps, ci = 4, ri = 66) Transitional vertebrae with haemal canal: (0) present; (1) absent.

State 0 to *A. luetkenii vs*. state 1 in Mirande (2010).

Pectoral girdle

Pectoral fins

230. (3 steps, ci = 33, ri = 60) Margin of first pectoral ray in adult specimens: (0) not serrated; (1) conspicuously serrated.

State 0 to *D. langei vs.*inapplicable data (-) in Mirande (2010).

231. (10 steps, ci = 10, ri = 70) Base of second pectoral ray: (0) expanded, partially overlapping base of first pectoral ray, in medial view; (1) reduced, similar to that of posterior rays.

Cleithrum

232. (3 steps, ci = 33, ri = 60) Anterior margin of cleithrum: (0) slightly sinuous; (1) with an anterior angle expanding laterally attachment site for sternohyoideus muscle.

233. (3 steps, ci = 33, ri = 50) Form of posterior margin of cleithrum: (0) convex or slightly sinuous just dorsal to pectoral-fin insertion; (1) with a notch just anterior to pectoral-fin insertion.

234. (33 steps, ci = 3, ri = 68) Posterior margin of cleithrum: (0) without a concavity ventral to first postcleithrum; (1) with a concavity.

State 0&1 to *D. iguape* and *A. luetkenii vs*. state 0 in Mirande (2010).

235. (14 steps, ci = 7, ri = 27) Posterior margin of cleithrum: (0) with a concavity not pronounced or lacking; (1) a markedly concave margin, almost forming a straight angle.

236. (1 step, ci = 100, ri = 100) Medial laminar expansion at dorsal tip of cleithrum: (0) absent; (1) present.

237. (2 steps, ci = 50, ri = 50) Dorsal development of cleithrum: (0) much extended dorsally to mesocoracoid; (1) mesocoracoid almost reaching dorsal tip of cleithrum.

Coracoid

238. (6 steps, ci = 16, ri = 28) Development of medial lamella of coracoid: (0) not expanded; (1) expanded as a keel.

239. (3 steps, ci = 33, ri = 93) Bony ridge of coracoid between base of mesocoracoid and ventral margin of interosseous space: (0) absent; (1) present.

240. (1 step) Anterior extension of coracoid ventral lamella: (0) reaching cleithrum; (1) not reaching cleithrum.

241. (2 steps, ci = 50, ri = 66) Ventral extension of coracoid lamella: (0) reaching ventral margin of cleithrum; (1) not reaching ventral margin of cleithrum, which is ventrally projected in relation to coracoid.

242. (2 steps, ci = 50, ri = 85) Anterior limit of interosseous space: (0) formed by dorsal margin of coracoid medial lamella and dorsal margin of cleithrum; (1) formed by dorsal margin of coracoid medial lamella and an oblique bony ridge just ventral to dorsal margin of cleithrum.

243. (5 steps, ci = 20, ri = 71) Coracoid foramen: (0) absent or reduced to a small pore; (1) well developed.

Scapula

244. (8 steps, ci = 12, ri = 36) Process of scapula forming anterior border of scapular foramen: (0) present; (1) absent.

State 0 to *D. langei vs.*state 1 in Mirande (2010).

Mesocoracoid

245. (4 steps, ci = 25, ri = 40) Articulation between a descendent process of mesocoracoid and dorsal margin of scapula: (0) absent or reduced; (1) present, with conspicuous articular margins.

246. (1 step, autapomorphy) Ventral articulation of mesocoracoid: (0) anteriorly with coracoid and posteriorly with scapula; (1) only with coracoid.

Postcleithra

247. (2 steps, ci = 50, ri = 80) First postcleithrum: (0) present; (1) absent.

248. (5 steps, ci = 20, ri = 80) Second postcleithrum: (0) present; (1) absent.

249. (6 steps, ci = 16, ri = 37) Third postcleithrum: (0) present; (1) absent.

250. (10 steps, ci = 10, ri = 80) Form of third postcleithrum: (0) slender, without associated lamella; (1) with a posterior lamella.

251. (3 steps, ci = 33, ri = 50) Dorsal development of third postcleithrum: (0) well projected dorsal to posterior region of scapula; (1) not projected dorsally to posterior region of scapula.

Posttemporal

252. (12 steps, ci = 8, ri = 38) Position of ventral end of posttemporal: (0) anterior to lateral margin of epioccipital; (1) lateral or posterior to epioccipital.

253. (15 steps, ci = 6, ri = 54) Position of ventral end of posttemporal: (0) overlapping laterally, or anterior to lateral margin of epioccipital; (1) posterior to epioccipital.

Supracleithrum

254. (4 steps, ci = 25, ri = 92) Ventral exit of supracleithrum laterosensory canal: (0) medial, laterally covered by a continuous posterior lamella of supracleithrum; (1) posterior, just ventral to lamella of supracleithrum.

255. (1 step, ci = 100, ri = 100) Fusion between posttemporal and supracleithrum: (0) absent; (1) present.

Pelvic girdle

Pelvic fin

256. (1 step, autapomorphy) First pelvic-fin ray: (0) not branched; (1) branched.

257. (2 steps, ci = 50, ri = 66) Relative length of males first pelvic-fin ray: (0) not projected; (1) projected from remaining rays.

258. (25 steps, ci = 4, ri = 42) Number of branched pelvic-fin rays: (0) six or less; (1) seven or more.

State 1 to *A. luetkenii vs*. state 0 in Mirande (2010).

259. (4 steps, ci = 25, ri = 70) Number of branched pelvic-fin rays: (0) seven or less; (1) eight or more.

Pelvic bone

260. (2 steps, ci = 50, ri = 50) Pelvic bone: (0) not bifurcated anteriorly; (1) bifurcated, with a conspicuous notch.

261. (3 steps, ci = 33, ri = 33) Articulation between contralateral pelvic bones: (0) through ligaments; (1) with bony interdigitations between ischiatic processes.

262. (6 steps, ci = 16, ri = 37) Anterior extension of pelvic-bone principal axis: (0) not projected anterior to lateral lamellae; (1) projected anterior to lateral lamellae of pelvic bone.

263. (1 step, ci = 100, ri = 100) Anterior tip of pelvic bone: (0) rounded and limited by a small cartilage; (1) pointed and lacking an associated cartilage, frequently projected outside body wall.

264. (2 steps, ci = 50, ri = 92) Dorsal longitudinal ridge on medial lamella of pelvic bone: (0) present; (1) absent.

Epineurals, supraneurals, and dorsal fin skeleton

Dorsal fin

265. (13 steps, ci = 7, ri = 57) Relative position of dorsal-fin anterior insertion: (0) anterior or at vertical through pelvic-fin origin; (1) posterior to vertical through pelvic-fin origin.

State 1 to *D. iguape* and *D. langei vs.*state 0 in Mirande (2010).

266. (22 steps, ci = 4, ri = 75) Dorsal-fin rays articulated with first dorsal pterygiophore: (0) two; (1) three or four.

State 0 to *D. iguape* and *D. langei vs.*state 1 in Mirande (2010).

267. (1 step, ci = 100, ri = 100) Anteriorly directed spine formed by first dorsal-fin ray: (0) absent; (1) present.

268. (6 steps, ci = 16, ri = 44) Dorsal fin of adult males: (0) not extended posteriorly; (1) with anterior rays extended posteriorly to a position close to adipose fin.

269. (2 steps, ci = 50, ri = 50) Length of last unbranched dorsal-fin ray in adult males: (0) not projected; (1) projected as a filament.

270. (11 steps, ci = 9, ri = 70) Number of branched dorsal-fin rays: (0) eight or less; (1) nine or more.

271. (5 steps, ci = 20, ri = 60) Relative length of anterior dorsal-fin rays: (0) not reaching tip of posterior rays when adpressed; (1) reaching tip of posterior rays when adpressed.

272. (8 steps, ci = 12, ri = 73) Number of dorsal-fin rays on last pterygiophore: (0) one; (1) two, adnates.

State 1 to *A. luetkenii vs*. state 0 in Mirande (2010).

Intermuscular bones

273. (2 steps, ci = 50, ri = 50) Myorhabdoi: (0) absent; (1) present.

274. (7 steps, ci = 14, ri = 40) Position of anteriormost epineurals: (0) lateral to fourth or fifth vertebra; (1) from cranium or posttemporal fossa.

Dorsal pterygiophores

275. (1 step, ci = 100, ri = 100) Predorsal spine formed by first dorsal pterygiophore: (0) absent; (1) present.

276. (11 steps, ci = 9, ri = 76) Number of dorsal pterygiophores: (0) nine; (1) 10 or more.

277. (10 steps, ci = 10, ri = 35) Number of dorsal pterygiophores: (0) 10 or less; (1) 11 or more.

278. (5 steps, ci = 20, ri = 33) Number of dorsal pterygiophores: (0) 11 or less; (1) 12 or more.

Supraneurals

279. (6 steps, ci = 16, ri = 79) Supraneural anterior to neural spine of fourth vertebra: (0) absent or much reduced; (1) present, vertically elongated.

280. (18 steps, ci = 5, ri = 76) Number of supraneurals: (0) four or less; (1) five or more.

State 1 to *D. langei vs.*state 0 in Mirande (2010).

281. (12 steps, ci = 8, ri = 57) Number of supraneurals: (0) seven or less; (1) eight or more.

282. (24 steps, ci = 4, ri = 75) Bony lamellae associated to supraneurals: (0) absent or reduced; (1) wider than main axis of supraneurals.

State 1 to *A. luetkenii vs*. state 0&1 in Mirande (2010).

283. (6 steps, ci = 16, ri = 28) Position of last supraneural: (0) two or less vertebrae in front of first dorsal pterygiophore; (1) more than two vertebrae in front.

Anal fin and pterygiophores

Anal fin

284. (7 steps, ci = 14, ri = 68) Anal-fin position: (0) posterior or almost posterior to vertical line through last dorsal-fin ray; (1) ventral to dorsal fin.

285. (8 steps, ci = 12, ri = 72) Number of unbranched anal-fin rays: (0) three or less; (1) four or more.

286. (2 steps, ci = 50, ri = 91) Number of branched anal-fin rays: (0) 10 or less; (1) 11 or more.

287. (18 steps, ci = 5, ri = 59) Number of branched anal-fin rays: (0) 17 or less; (1) 18 or more.

288. (22 steps, ci = 4, ri = 65) Number of branched anal-fin rays: (0) 24 or less; (1) 25 or more.

State 0 to *A. luetkenii vs*. state 1 in Mirande (2010).

289. (11 steps, ci = 9, ri = 44) Number of branched anal-fin rays: (0) 34 or less; (1) 35 or more.

290. (3 steps, ci = 33, ri = 50) Form and length of anterior anal-fin rays: (0) similar to posterior ones; (1) longer and compressed laterally.

291. (1 step) Number of rays on last anal pterygiophore: (0) two, adnates; (1) one.

Anal-fin pterygiophores

292. (2 steps, ci = 50, ri = 50) Anterior notch on first anal pterygiophore: (0) absent; (1) present.

293. (5 steps, ci = 20, ri = 33) Number of anal pterygiophores anterior to first haemal spine: (0) three or less; (1) four or more.

294. (12 steps, ci = 16, ri = 69) Proximal and medial anal pterygiophores: (0) fused on anterior five pterygiophores; (1) fused in most pterygiophores; (2) medial pterygiophores absent or completely fused with proximal ones.

295. (2 steps, ci = 50, ri = 93) Lateral lamellae on anterior anal pterygiophores: (0) absent; (1) present.

Caudal skeleton

Epurals

296. (6 steps, ci = 16, ri = 16) Number of epurals: (0) one; (1) two or three.

297. (3 steps, ci = 33, ri = 77) Number of epurals: (0) one or two; (1) three.

Hypurals

298. (6 steps, ci = 16, ri = 50) Fusion of second hypural to last compound centrum: (0) absent; (1) present.

299. (3 steps, ci = 33, ri = 0) Fusion between first and second hypurals: (0) absent; (1) present.

300. (4 steps, ci = 25, ri = 62) Posterior margin of third hypural: (0) equal or more slender than posterior margin of fourth hypural; (1) deeper than posterior margin of fourth hypural.

Procurrent rays

301. (2 steps, ci = 50, ri = 50) Ventral procurrent caudal-fin rays of adult males: (0) slender; (1) laminar.

302. (5 steps, ci = 20, ri = 50) Number of ventral procurrent caudal-fin rays: (0) 11 or less; (1) 12 or more.

303. (3 steps, ci = 33, ri = 33) Ventral procurrent caudal-fin rays of adult males: (0) not projected from peduncle musculature and skin; (1) projected ventrally from peduncle musculature and skin.

304. (1 step, ci = 100, ri = 100) Caudal-fin bony stays: (0) absent; (1) present.

305. (1 step, ci = 100, ri = 100) Anterior ventral procurrent caudal-fin rays: (0) paired, only distally fused; (1) with longitudinal stays; (2) fused in laminar medial bones.

Uroneurals

306. (15 steps, ci = 6, ri = 70) Uroneurals: (0) one pair; (1) two pairs.

State 0 to *D. iguape* and *D. langei vs.*state 1 in Mirande (2010).

Bony hooks

Distribution

307. (31 steps, ci = 3, ri = 59) Bony hooks on fins: (0) absent; (1) present in adult males.

308. (4 steps, ci = 25, ri = 0) Anal-fin bony hooks in adult males of species bearing hooks on fins: (0) absent; (1) present.

Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

309. (19 steps, ci = 5, ri = 18) Pelvic-fin bony hooks in adult males of species bearing hooks on fins: (0) absent; (1) present.

State 1 to *A. luetkenii vs*. state 0 in Mirande (2010). Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

310. (7 steps, ci = 14, ri = 57) Pectoral-fin bony hooks in adult males of species bearing hooks on fins: (0) absent; (1) present.

Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

311. (10 steps, ci = 10, ri = 57) Dorsal-fin bony hooks in adult males of species bearing hooks on fins: (0) absent; (1) present.

Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

312. (4 steps, ci = 25, ri = 78) Caudal-fin bony hooks in adult males of species bearing hooks on fins: (0) absent; (1) present.

Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

313. (9 steps, ci = 11, ri = 66) Bony hooks on base of pelvic-fin rays of adult males: (0) absent, or in small number compared to on segmented portion of rays; (1) as numerous as on segmented portion of rays.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010). Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

314. (9 steps, ci = 11, ri = 70) Bony hooks on last pelvic-fin ray of adult males: (0) absent or reduced in number; (1) as numerous as in other rays.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010). Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

315. (14 steps, ci = 7, ri = 18) Bony hooks on first pelvic-fin ray of adult males: (0) absent; (1) present.

State 0 to *A. luetkenii vs*. inapplicable data (-) in Mirande (2010). Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

316. (5 steps, ci = 40, ri = 66) Position of anal-fin bony hooks of adult males: (0) paired and ordered laterally or posterolaterally; (1) medially positioned and oriented posteriorly; (2) asymmetrically disposed and irregularly arranged.

State 0 to *A. luetkenii vs*. state 2 in Mirande (2010). Inapplicable data (-) to *D. iguape vs*. missing data (?) in Mirande (2010).

Scales

Morphology

317. (6 steps, ci = 50, ri = 57) Scales: (0) cycloid; (1) ctenoid; (2) spinoid; (3) crenate.

318. (2 steps, ci = 50, ri = 0) Anterior margin of scales: (0) uniformly curved or slightly undulated; (1) with conspicuous undulations.

319. (10 steps, ci = 10, ri = 74) *Circulii* on posterior field of scales: (0) present; (1) absent.

320. (18 steps, ci = 5, ri = 34) *Radii* on scales: (0) absent or reduced in number; (1) present and numerous on most scales.

321. (10 steps, ci = 20, ri = 79) *Radii* orientated to anterior field of scales: (0) present; (1) only a longitudinal groove with not defined margins; (2) absent.

322. (5 steps, ci = 11, ri = 68) *Radii* of scales: (0) not converging at focus; (1) converging at focus.

323. (1 step) Semicircular grooves on posterior field of scales: (0) absent; (1) present.

Scale distribution

324. (7 steps, ci = 14, ri = 40) Scales on supraoccipital spine: (0) not covering supraoccipital spine; (1) completely covering supraoccipital spine.

325. (7 steps, ci = 14, ri = 40) Predorsal scales: (0) covering entire predorsal region; (1) leaving a naked area anterior to dorsal fin.

326. (1 step, ci = 100, ri = 100) Ventral serrae: (0) absent; (1) present.

327. (10 steps, ci = 10, ri = 47) Scales covering anal-fin base: (0) one or two rows of scales covering anal-fin base; (1) several rows covering basal third of anal fin.

328. (17 steps, ci = 5, ri = 54) Scales covering caudal-fin lobes: (0) covering only their base; (1) covering one third of their length.

Muscles and ligaments

Cranial musculature

329. (1 step, ci = 100, ri = 100) Ventral division of tendon from *adductor mandibulae* inserted on dentary: (0) absent; (1) present.

330. (11 steps, ci = 9, ri = 70) Longitudinal position of insertion of *adductor mandibulae* tendon on dentary: (0) on vertical through posterior half of Meckelian cartilage; (1) on vertical through middle or anterior half of Meckelian cartilage.

331. (6 steps, ci = 33, ri = 63) Insertion of *adductor mandibulae* tendon on dentary: (0) ventral to Meckelian cartilage; (1) anterior to Meckelian cartilage; (2) on a medial process of the dentary.

332. (9 steps, ci = 11, ri = 46) Posterior attachment of section A1 from *adductor mandibulae*: (0) principally attached to vertical arm of preopercle; (1) restricted or almost restricted to horizontal arm of preopercle.

333. (3 steps, ci = 33, ri = 80) Medial tendon from section A1 of *adductor mandibulae*: (0) on quadrate, near its articulation with preopercle; (1) on preopercle, posteriorly to quadrate.

334. (1 step, ci = 100, ri = 100) Anterior insertion of section A1 from *adductor mandibulae*: (0) on maxilla; (1) on coronoid process of dentary.

335. (10 steps, ci = 10, ri = 50) Contact between dorsal margin of *adductor mandibulae* and ventral margin of *dilator operculi*: (0) absent; (1) present.

336. (9 steps, ci = 11, ri = 46) Anterior extension of *adductor arcus palatini*: (0) covering most of endopterygoid dorsal surface; (1) covering only half of endopterygoid.

State 1 to *D. langei vs.* missing data (?) in Mirande (2010).

337. (6 steps, ci = 16, ri = 68) Posterior region of *levator arcus palatini*: (0) limited laterally by *adductor mandibulae* and medially by *adductor arcus palatini*; (1) limited lateral and medially by different sections of *adductor mandibulae*.

State 0 to *D. langei vs.* missing data (?) in Mirande (2010).

338. (1 step, ci = 100, ri = 100) Origin of *dilator operculi*: (0) dorsal to posterior margin of eye; (1) completely posterior to vertical line through posterior margin of eye.

Postcranium

339. (31 steps, ci = 6, ri = 70) Pseudotympanum limited by first pleural rib, *lateralis superficialis*, second pleural rib, *obliquus inferioris* and *obliquus superioris*: (0) absent; (1) present.

State 0 to *D. langei vs.* missing data (?) in Mirande (2010).

340. (4 steps, ci = 50, ri = 66) Insertion of pterotic aponeurosis: (0) on pterotic spine or lateral surface of horizontal semicircular canal; (1) on a lobe situated dorsally to horizontal semicircular canal; (2) on pterotic or sphenotic, much dorsal to horizontal semicircular canal.

Coloration and miscellaneous characters

Coloration

341. (22 steps, ci = 4, ri = 71) First humeral spot: (0) vertically elongated; (1) rounded or horizontally ovate.

State 1 to *D. iguape*, *D. langei* and *H. luetkenii vs*. state 0 in Mirande (2010). This character following modifications of Carvalho (2011).

342. (15 steps, ci = 6, ri = 48) Second humeral spot: (0) absent or diffuse; (1) present as a conspicuous vertical bar.

343. (6 steps, ci = 16, ri = 81) Dark conspicuous spot on dorsal fin: (0) absent; (1) present.

344. (4 steps, ci = 25, ri = 40) Horizontal line of chromatophores just dorsal to anal-fin base: (0) absent; (1) present.

345. (24 steps, ci = 12, ri = 22) Color of caudal-fin lobes: (0) symmetrically hyaline, yellowish, reddish or violaceous; (1) ventral lobe orange or reddish, and dorsal lobe hyaline; (2) ventral lobe dark brown or black and dorsal lobe hyaline; (3) both lobes dark brown or black.

346. (1 step, ci = 100, ri = 100) Diffuse spots on flanks of juveniles: (0) absent; (1) present.

347. (7 steps, ci = 14, ri = 50) A little spot on each scale of flanks: (0) absent; (1) present.

348. (3 steps, ci = 33, ri = 33) Dark spot covering the entire depth of caudal peduncle: (0) absent; (1) present.

Miscellaneous

349. (6 steps, ci = 16, ri = 37) Ventral confluence of gill membranes: (0) confluent anteriorly, not covering the isthmus; (1) confluent posteriorly, covering the isthmus but not attached to it; (2) confluent each other and with the isthmus.

350. (10 steps, ci = 10, ri = 80) Sclerotic bones: (0) a single bone anteroventrally open; (1) two bones separated by cartilages.

Missing data (?) to *D. langei* and *A. luetkenii vs*. state 0 in Mirande (2010).

351. (3 steps, ci = 33, ri = 50) Nostrils: (0) rounded, divided by a skin fold; (1) two separate nostrils at each side of snout.

352. (5 steps, ci = 20, ri = 80) Gill-derived gland on males: (0) absent; (1) present.

Missing data (?) to *A. luetkenii vs*. state 0 in Mirande (2010).

353. (2 steps, ci = 50, ri = 80) Glandular tissue of granular appearance on caudal fin of mature males: (0) absent; (1) present.

Missing data (?) to *A. luetkenii vs*. state 0 in Mirande (2010).

354. (2 steps, ci = 50, ri = 66) Hypertrophied ventral caudal-peduncle squamation: (0) absent.

355. (2 steps, CI = 50, RI = 66) Caudal gland cells consisting of modified mucous cells: (0) absent; (1) present.

State 0 to *A. luetkenii vs*. missing data (?) in Mirande (2010).

356. (5 steps, ci = 20, ri = 75) Adipose fin: (0) present; (1) absent.

357. (1 step, ci = 100, ri = 100) Papillae on tongue: (0) not aligned; (1) forming longitudinal rows anteriorly.

358. (4 steps, ci = 25, ri = 57) Insemination: (0) absent; (1) present.

State 0 to *D. iguape*, D. langei and *A. luetkenii vs*. missing data (?) in Mirande (2010).

359. (10 steps, ci = 20, ri = 75) Type of spermatozoa: (0) aquasperm; (1) introsperm.

360. (3 steps, ci = 33, ri = 60) Sperm storage area on testes: (0) absent or small; (1) present, as broad as spermatogenic area.

361. (2 steps, ci = 50, ri = 50) Number of 2n chromosomes: (0) 36 to 40; (1) 46 or more.

State 1 to *A. luetkenii vs*. missing data (?) in Mirande (2010).

362. (7 steps, ci = 14, ri = 25) Number of 2n chromosomes: (0) 48 or less; (1) 50 or more.

State 1 to *A. luetkenii vs*. missing data (?) in Mirande (2010).

363. (13 steps, ci = 7, ri = 66) Number of 2n chromosomes: (0) 50 or less; (1) 52 or more.

State 0 to *A. luetkenii vs*. missing data (?) in Mirande (2010).

364. (3 steps, ci = 33, ri = 77) Number of 2n chromosomes: (0) 52 or less; (1) 54 or more.

State 0 to *A. luetkenii vs*. missing data (?) in Mirande (2010).

365. (1 step, ci = 100, ri = 100) Number of 2n chromosomes: (0) 56 or less; (1) 58 or more.

State 0 to *A. luetkenii vs*. missing data (?) in Mirande (2010).

Comments about the characters 361 to 365

Kavalco & Moreira- Filho (2003) performed cytogenetic studies with of *A. parahybae* (9 specimens), *A. intermedius* (28 specimens), both from Paraitinga river, and *A. giton* (21 specimens) from the Paraitinga river and from Jacuí stream, all belonging to Paraíba do Sul river basin. *Astyanax parahybae* presented 2n = 48 chromosomes, *A. intermedius* possess 2n = 50 chromosomes, *A. giton* presented 2n = 50 chromosomes. In 2009, Kavalco *et al.* found in *A. hastatus* 2n = 50 chromosomes.

Mendes (2009) analyzed cytogenetically18 specimens of *A. luetkenii* from laguna dos Patos system and rio Tramandaí system, and 8 specimens of *D. stgimaturus* from rio Tramandaí system, in both analysis were found 50 chromosomes.

Appendix III. Common synapomorphies obtained in trees used to construct the final hypothesis. Node numbers are those assigned by TNT.

Puntius tetrazona:
No autapomorphies

Distichodus maculatus:
Char. 14: 0 > 1
Char. 103: 1 > 0
Char. 159: 0 > 1
Char. 183: 0 > 1
Char. 274: 0 > 1
Char. 278: 0 > 1
Char. 285: 0 > 1
Char. 298: 1 > 0
Char. 299: 0 > 1
Char. 317: 0 > 1
Char. 320: 1 > 0
Char. 328: 0 > 1

Apareiodon affinis:
Char. 164: 0 > 1
Char. 212: 1 > 0
Char. 227: 0 > 1

Parodon nasus:
No autapomorphies

Cyphocharax spilotus:
Char. 3: 0 > 1
Char. 76: 1 > 0
Char. 82: 1 > 0
Char. 151: 0 > 1
Char. 170: 0 > 1
Char. 191: 0 > 1
Char. 228: 0 > 1
Char. 320: 1 > 0

Prochilodus lineatus:
Char. 10: 0 > 1
Char. 53: 1 > 0
Char. 71: 0 > 1
Char. 110: 1 > 0
Char. 169: 0 > 1
Char. 227: 0 > 1
Char. 234: 1 > 0
Char. 253: 0 > 1
Char. 324: 0 > 1
Char. 332: 1 > 0

Leporinus striatus:
Char. 20: 0 > 1
Char. 34: 0 > 1
Char. 35: 1 > 0
Char. 195: 0 > 1
Char. 212: 1 > 0
Char. 244: 0 > 1
Char. 279: 1 > 0
Char. 351: 0 > 1

Characidium borellii:
Char. 213: 0 > 1
Char. 235: 0 > 1
Char. 307: 0 > 1

Characidium rachovii:
Char. 88: 0 > 1
Char. 91: 0 > 1
Char. 228: 0 > 1
Char. 278: 0 > 1

Hemiodus cf. *thayeria*:
Char. 14: 0 > 1
Char. 37: 1 > 0
Char. 38: 1 > 0
Char. 47: 0 > 1
Char. 65: 0 > 1
Char. 75: 0 > 1
Char. 89: 0 > 1
Char. 136: 0 > 1
Char. 151: 0 > 1
Char. 171: 1 > 0
Char. 183: 0 > 1
Char. 219: 0 > 1
Char. 220: 0 > 1
Char. 227: 0 > 1
Char. 266: 1 > 0
Char. 281: 0 > 1
Char. 282: 1 > 0
Char. 298: 1 > 0
Char. 299: 0 > 1
Char. 322: 1 > 0
Char. 345: 0 > 2

Carnegiella strigata:
Char. 122: 1 > 0
Char. 189: 0 > 1
Char. 356: 0 > 1

Thoracocharax stellatus:
Char. 39: 1 > 0
Char. 64: 0 > 1
Char. 135: 0 > 1
Char. 155: 0 > 1
Char. 182: 1 > 0
Char. 213: 0 > 1
Char. 278: 0 > 1
Char. 289: 0 > 1
Char. 327: 0 > 1
Char. 349: 0 > 1

Acestrorhynchus pantaneiro:
Char. 11: 0 > 1
Char. 12: 0 > 1
Char. 83: 0 > 1
Char. 159: 0 > 1
Char. 194: 1 > 0
Char. 228: 0 > 1
Char. 288: 1 > 0
Char. 341: 0 > 1

Rhaphiodon vulpinus:
Char. 1: 0 > 1
Char. 14: 1 > 0
Char. 35: 1 > 0
Char. 37: 0 > 1
Char. 80: 0 > 1
Char. 89: 1 > 0
Char. 110: 0 > 1
Char. 143: 0 > 1
Char. 160: 0 > 1
Char. 175: 0 > 1
Char. 181: 0 > 1
Char. 184: 1 > 0
Char. 192: 0 > 1
Char. 193: 0 > 1
Char. 203: 0 > 1
Char. 213: 0 > 1
Char. 214: 0 > 1
Char. 220: 1 > 0
Char. 237: 0 > 1
Char. 238: 0 > 1
Char. 248: 0 > 1
Char. 249: 0 > 1
Char. 254: 0 > 1
Char. 262: 0 > 1
Char. 272: 0 > 1
Char. 273: 0 > 1
Char. 289: 0 > 1
Char. 327: 0 > 1
Char. 337: 0 > 1
Char. 363: 0 > 1
Char. 364: 0 > 1

Hoplias cf. *malabaricus*:
Char. 38: 1 > 0
Char. 55: 0 > 1
Char. 110: 1 > 0
Char. 137: 0 > 1
Char. 150: 0 > 1
Char. 154: 0 > 1
Char. 159: 0 > 1
Char. 160: 0 > 1
Char. 163: 0 > 1
Char. 170: 1 > 0
Char. 172: 1 > 0
Char. 181: 0 > 1
Char. 183: 0 > 1
Char. 195: 1 > 0
Char. 199: 0 > 1
Char. 200: 0 > 1
Char. 202: 0 > 1
Char. 211: 0 > 1
Char. 213: 0 > 1
Char. 240: 0 > 1
Char. 241: 0 > 1
Char. 244: 0 > 1
Char. 253: 0 > 1
Char. 262: 0 > 1
Char. 278: 0 > 1
Char. 298: 1 > 0

Pyrrhulina australis:
Char. 4: 1 > 0
Char. 39: 1 > 0
Char. 62: 0 > 1
Char. 65: 0 > 1
Char. 91: 0 > 1
Char. 142: 0 > 1
Char. 164: 0 > 1
Char. 184: 1 > 0
Char. 212: 1 > 0
Char. 249: 0 > 1
Char. 252: 1 > 0
Char. 271: 0 > 1
Char. 281: 0 > 1
Char. 332: 0 > 1
Char. 335: 1 > 0

Alestes cf. *macrophthalmus*:
No autapomorphies

Brycinus carolinae:
Char. 22: 0 > 1
Char. 41: 0 > 1
Char. 226: 1 > 0

Bryconaethiops macrops:
Char. 90: 1 > 0
Char. 123: 0 > 1
Char. 192: 0 > 1
Char. 260: 0 > 1
Char. 280: 1 > 0

Chalceus macrolepidotus:
Char. 27: 0 > 1
Char. 72: 0 > 1
Char. 74: 0 > 1
Char. 75: 0 > 1
Char. 81: 1 > 0
Char. 123: 0 > 1
Char. 136: 0 > 1
Char. 137: 0 > 1
Char. 183: 0 > 1
Char. 226: 1 > 0
Char. 286: 1 > 0
Char. 363: 0 > 1

Micralestes stormsi:
Char. 3: 0 > 1
Char. 65: 0 > 1
Char. 70: 0 > 1
Char. 77: 0 > 1
Char. 109: 0 > 1
Char. 125: 0 > 1
Char. 151: 0 > 1
Char. 179: 0 > 1
Char. 228: 0 > 1
Char. 234: 0 > 1
Char. 250: 1 > 0
Char. 279: 1 > 0
Char. 282: 0 > 1

Metynnis maculatus:
Char. 21: 1 > 0
Char. 51: 0 > 1
Char. 81: 1 > 0
Char. 151: 0 > 1
Char. 188: 0 > 1
Char. 229: 0 > 1
Char. 266: 0 > 1
Char. 289: 0 > 1
Char. 339: 0 > 1
Char. 341: 0 > 1

Piaractus mesopotamicus:
Char. 74: 0 > 1
Char. 92: 0 > 1
Char. 103: 1 > 0
Char. 112: 0 > 1
Char. 163: 0 > 1
Char. 195: 1 > 0
Char. 206: 0 > 1
Char. 213: 0 > 1

Serrasalmus maculatus:
Char. 2: 1 > 0
Char. 11: 0 > 1
Char. 45: 0 > 1
Char. 88: 0 > 1
Char. 143: 0 > 1
Char. 159: 0 > 1
Char. 299: 0 > 1

Agoniates anchovia:
Char. 9: 0 > 1
Char. 48: 1 > 0
Char. 64: 1 > 0
Char. 71: 1 > 0
Char. 86: 0 > 1
Char. 157: 0 > 1
Char. 183: 1 > 0
Char. 199: 1 > 0
Char. 219: 0 > 1
Char. 223: 0 > 1
Char. 235: 0 > 1
Char. 251: 0 > 1
Char. 261: 0 > 1
Char. 296: 1 > 0
Char. 319: 0 > 1
Char. 332: 0 > 1

Iguanodectes geisleri:
Char. 46: 0 > 1
Char. 72: 0 > 1
Char. 114: 0 > 1
Char. 134: 1 > 0
Char. 135: 1 > 0
Char. 196: 0 > 1
Char. 235: 0 > 1
Char. 285: 1 > 0
Char. 288: 1 > 0

Char. 79: 0 > 1
Char. 172: 1 > 0
Char. 352: 1 > 0

Piabucus melanostomus:
Char. 1: 0 > 1
Char. 53: 1 > 0
Char. 65: 0 > 1
Char. 122: 1 > 0
Char. 184: 1 > 0
Char. 233: 0 > 1
Char. 238: 0 > 1
Char. 249: 0 > 1
Char. 262: 0 > 1
Char. 270: 1 > 0
Char. 274: 0 > 1
Char. 276: 1 > 0
Char. 284: 0 > 1
Char. 289: 0 > 1
Char. 335: 1 > 0

Brycon falcatus:
Char. 72: 0 > 1

Brycon meeki:
Char. 13: 1 > 0
Char. 53: 1 > 0
Char. 297: 0 > 1

Brycon orbignyanus:
Char. 47: 1 > 0
Char. 53: 1 > 0
Char. 125: 0 > 1
Char. 130: 0 > 1
Char. 139: 0 > 1
Char. 179: 0 > 1
Char. 192: 0 > 1
Char. 193: 0 > 1
Char. 266: 0 > 1
Char. 336: 1 > 0

Aphyocharax anisitsi:
Char. 19: 0 > 1
Char. 313: 0 > 1
Char. 315: 0 > 1

Aphyocharax dentatus:
Char. 162: 0 > 1
Char. 258: 0 > 1

Aphyocharax nattereri:
Char. 21: 1 > 0
Char. 47: 1 > 0

Paragoniates alburnus:
Char. 12: 1 > 0
Char. 238: 0 > 1
Char. 258: 0 > 1
Char. 327: 0 > 1

Phenagoniates macrolepis:
Char. 77: 1 > 0
Char. 319: 1 > 0
Char. 320: 1 > 0
Char. 356: 0 > 1

Prionobrama paraguayensis:
Char. 130: 0 > 1
Char. 162: 0 > 1
Char. 200: 0 > 1
Char. 231: 1 > 0
Char. 235: 0 > 1
Char. 246: 0 > 1
Char. 296: 1 > 0
Char. 335: 1 > 0

Xenagoniates bondi:
Char. 91: 1 > 0
Char. 108: 0 > 1
Char. 109: 0 > 1
Char. 159: 0 > 1
Char. 184: 1 > 0
Char. 235: 0 > 1
Char. 244: 1 > 0
Char. 249: 0 > 1
Char. 283: 0 > 1
Char. 331: 0 > 1

Acestrocephalus sardina:
Char. 233: 1 > 0
Char. 282: 1 > 0
Char. 341: 1 > 0

Cynopotamus argenteus:
Char. 12: 0 > 1
Char. 51: 0 > 1
Char. 184: 0 > 1

Galeocharax humeralis:
Char. 21: 0 > 1
Char. 34: 0 > 1
Char. 38: 1 > 0
Char. 57: 0 > 1

Heterocharax macrolepis:
Char. 59: 0 > 1
Char. 85: 0 > 1
Char. 155: 0 > 1
Char. 243: 0 > 1

Hoplocharax goethei:
Char. 66: 0 > 1
Char. 69: 0 > 1
Char. 91: 0 > 1
Char. 184: 1 > 0
Char. 192: 0 > 1
Char. 193: 0 > 1
Char. 258: 1 > 0
Char. 270: 1 > 0
Char. 276: 1 > 0
Char. 303: 0 > 1

Lonchogenys ilisha:
Char. 53: 0 > 1
Char. 70: 1 > 0
Char. 149: 0 > 1
Char. 325: 0 > 1

Phenacogaster tegatus:
Char. 154: 1 > 0
Char. 155: 1 > 0
Char. 309: 1 > 0
Char. 310: 0 > 1
Char. 352: 0 > 1

Roeboides microlepis:
Char. 319: 1 > 0

Roeboides descalvadensis:
Char. 15: 0 > 1
Char. 155: 1 > 0
Char. 188: 0 > 1
Char. 325: 0 > 1

Poptella paraguayensis:
No autapomorphies

Stethaprion erythrops:
Char. 69: 1 > 0
Char. 262: 0 > 1

Char. 277: 0 > 1
Char. 289: 0 > 1
Char. 309: 1 > 0
Char. 323: 0 > 1
Char. 342: 1 > 0

Tetragonopterus argenteus:
Char. 93: 0 > 1
Char. 318: 0 > 1
Char. 322: 0 > 1

Carlana eigenmanni:
Char. 23: 1 > 0
Char. 122: 1 > 0
Char. 192: 0 > 1

Rhoadsia altipinna:
Char. 3: 1 > 0
Char. 45: 0 > 1
Char. 96: 0 > 1
Char. 196: 1 > 0
Char. 250: 1 > 0
Char. 307: 1 > 0

Odontostilbe microcephala:
Char. 76: 0 > 1
Char. 188: 0 > 1
Char. 192: 0 > 1

Odontostilbe paraguayensis:
Char. 53: 1 > 0
Char. 244: 0 > 1

Odontostilbe pequira:
Char. 100: 1 > 0

Prodontocharax melanotus:
Char. 31: 0 > 1
Char. 96: 0 > 1
Char. 137: 0 > 1
Char. 141: 0 > 1
Char. 185: 0 > 1
Char. 191: 0 > 1
Char. 192: 0 > 1
Char. 282: 0 > 1
Char. 287: 1 > 0
Char. 335: 1 > 0

Serrapinnus calliurus:
Char. 229: 1 > 0
Char. 290: 0 > 1
Char. 316: 0 > 1

Mimagoniates rheocharis:
Char. 35: 1 > 0
Char. 44: 1 > 0
Char. 61: 0 > 1
Char. 185: 0 > 1
Char. 271: 1 > 0
Char. 276: 0 > 1
Char. 308: 1 > 0
Char. 354: 1 > 0
Char. 355: 1 > 0

Acrobrycon tarijae:
Char. 62: 1 > 0
Char. 173: 0 > 1
Char. 312: 0 > 1

Diapoma speculiferum:
Char. 151: 0 > 1
Char. 252: 1 > 0

Diapoma terofali:
Char. 193: 0 > 1

Pseudocorynopoma doriae:
Char. 46: 1 > 0
Char. 47: 1 > 0
Char. 151: 0 > 1
Char. 168: 1 > 2
Char. 238: 0 > 1
Char. 248: 0 > 1
Char. 268: 0 > 1
Char. 289: 0 > 1
Char. 294: 0 > 1
Char. 309: 1 > 0
Char. 341: 1 > 0

Attonitus ephimeros:
Char. 12: 0 > 1
Char. 47: 1 > 0
Char. 100: 0 > 1
Char. 109: 1 > 0
Char. 128: 0 > 1
Char. 157: 0 > 1
Char. 184: 1 > 0
Char. 188: 0 > 1
Char. 201: 0 > 1
Char. 235: 0 > 1
Char. 337: 0 > 1
Char. 358: 0 > 1

Bryconamericus agna:
Char. 104: 0 > 1
Char. 125: 0 > 1

Bryconamericus alpha:
No autapomorphies

Bryconamericus cf. exodon:
Char. 196: 1 > 0
Char. 313: 0 > 1

Bryconamericus cf. *iheringii*:
Char. 196: 1 > 0
Char. 310: 0 > 1

Bryconamericus mennii:
Char. 193: 1 > 0
Char. 307: 1 > 0

Bryconamericus cf. *rubropictus*:
No autapomorphies

Bryconamericus rubropictus:
Char. 64: 0 > 1
Char. 79: 0 > 1
Char. 92: 1 > 0
Char. 310: 0 > 1
Char. 311: 0 > 1

Bryconamericus scleroparius:
Char. 16: 0 > 1
Char. 21: 0 > 1
Char. 47: 1 > 0
Char. 64: 1 > 0
Char. 74: 0 > 1
Char. 129: 1 > 0
Char. 168: 1 > 2

Bryconamericus thomasi:
Char. 92: 1 > 0

Creagrutus anary:

Char. 10: 0 > 1
Char. 31: 0 > 1
Char. 252: 1 > 0
Char. 265: 1 > 0
Char. 309: 1 > 0
Char. 335: 1 > 0
Char. 336: 1 > 0

Creagrutus cf. taphorni:
Char. 64: 0 > 1
Char. 170: 1 > 0
Char. 244: 0 > 1

Cyanocharax alburnus:
Char. 151: 0 > 1
Char. 219: 0 > 1
Char. 258: 1 > 0

Hemibrycon dariensis:
Char. 139: 0 > 1

Hemibrycon surinamensis:
Char. 137: 0 > 1

Knodus breviceps:
Char. 252: 1 > 0

Odontostoechus lethostigmus:
Char. 119: 0 > 1
Char. 129: 0 > 1

Piabina argentea:
Char. 11: 0 > 1
Char. 172: 1 > 0
Char. 183: 0 > 1
Char. 229: 0 > 1
Char. 337: 0 > 1

Aphyocharacidium bolivianum:
Char. 31: 0 > 1
Char. 91: 1 > 0
Char. 107: 0 > 1
Char. 138: 0 > 1
Char. 143: 1 > 0
Char. 315: 0 > 1
Char. 339: 2 > 1

Aphyodite grammica:
Char. 10: 0 > 1
Char. 21: 1 > 0
Char. 64: 0 > 1
Char. 66: 0 > 1
Char. 136: 1 > 0
Char. 244: 0 > 1
Char. 328: 0 > 1
Char. 332: 0 > 1

Astyanax abramis:
Char. 170: 1 > 0
Char. 314: 0 > 1

Astyanax cf. *abramis*:
No autapomorphies

Astyanax asuncionensis:
Char. 67: 0 > 1

Astyanax cf. *asuncionensis*:
Char. 67: 0 > 1
Char. 314: 0 > 1

Astyanax chico:
No autapomorphies

Astyanax correntinus:
Char. 23: 0 > 1
Char. 125: 0 > 1
Char. 202: 0 > 1

Astyanax cf. *eigenmanniorum* 1:
No autapomorphies

Astyanax cf. *eigenmanniorum* 2:
No autapomorphies

Astyanax endy:
No autapomorphies

Astyanax latens:
Char. 69: 0 > 1
Char. 195: 1 > 0

Astyanax lineatus:
Char. 134: 0 > 1
Char. 172: 0 > 1

Astyanax paris:
Char. 67: 1 > 0
Char. 307: 1 > 0

Astyanax pelegrini:
Char. 93: 0 > 1
Char. 195: 1 > 0

Astyanax puka:
No autapomorphies
Astyanax cf. *rutilus*:
Char. 151: 0 > 1
Char. 195: 1 > 0
Char. 288: 0 > 1

Astyanax troya:
No autapomorphies

Aulixidens eugeniae:
Char. 14: 1 > 0
Char. 77: 1 > 0
Char. 94: 1 > 0
Char. 100: 0 > 1
Char. 134: 1 > 0
Char. 135: 1 > 0
Char. 147: 0 > 1
Char. 151: 0 > 1
Char. 156: 0 > 1
Char. 191: 0 > 1
Char. 210: 0 > 1
Char. 229: 0 > 1
Char. 252: 1 > 0
Char. 328: 0 > 1
Char. 339: 0 > 1

Axelrodia lindeae:
Char. 21: 1 > 0
Char. 64: 0 > 1
Char. 118: 1 > 0
Char. 146: 0 > 1
Char. 184: 1 > 0
Char. 185: 0 > 1
Char. 193: 1 > 0
Char. 201: 0 > 1
Char. 204: 1 > 0
Char. 258: 1 > 0
Char. 301: 0 > 1
Char. 303: 0 > 1
Char. 314: 0 > 1

Bario steindachneri:

Char. 21: 0 > 1
Char. 109: 0 > 1
Char. 266: 1 > 0
Char. 280: 0 > 1
Char. 282: 1 > 0
Char. 307: 0 > 1
Char. 321: 2 > 1
Char. 327: 0 > 1

Bramocharax bransfordii:
Char. 53: 0 > 1
Char. 280: 1 > 0
Char. 306: 1 > 0

Bryconexodon juruenae:
Char. 13: 1 > 0
Char. 38: 1 > 0
Char. 40: 0 > 1
Char. 54: 0 > 1
Char. 62: 2 > 1
Char. 154: 1 > 0
Char. 155: 1 > 0

Bryconops affinis:
Char. 189: 0 > 1

Bryconops melanurus:
Char. 62: 0 > 2
Char. 125: 0 > 1
Char. 154: 0 > 1

Engraulisoma taeniatum:
Char. 59: 0 > 1
Char. 156: 0 > 2
Char. 162: 0 > 1
Char. 210: 0 > 1
Char. 212: 1 > 0
Char. 219: 0 > 1
Char. 229: 0 > 1
Char. 231: 0 > 1
Char. 239: 1 > 0
Char. 261: 0 > 1
Char. 271: 0 > 1
Char. 283: 0 > 1
Char. 294: 2 > 0
Char. 300: 1 > 0
Char. 330: 0 > 1

Exodon paradoxus:
Char. 21: 0 > 1
Char. 118: 1 > 0
Char. 150: 0 > 1
Char. 161: 0 > 1
Char. 265: 1 > 0
Char. 307: 1 > 0
Char. 319: 1 > 0

Grundulus cochae:
Char. 6: 0 > 1
Char. 118: 1 > 0
Char. 122: 1 > 0
Char. 129: 0 > 1
Char. 130: 0 > 1
Char. 136: 0 > 1
Char. 137: 0 > 1
Char. 138: 1 > 0
Char. 149: 0 > 1
Char. 172: 0 > 1

Gymnocharacinus bergii:
Char. 12: 0 > 1
Char. 58: 0 > 1
Char. 91: 1 > 0
Char. 119: 0 > 1
Char. 139: 0 > 1
Char. 185: 0 > 1
Char. 245: 0 > 1
Char. 251: 0 > 1
Char. 283: 0 > 1
Char. 330: 0 > 1

Gymnocorymbus ternetzi:
Char. 289: 0 > 1
Char. 293: 0 > 1
Char. 306: 1 > 0

Hasemania nana:
Char. 64: 1 > 0
Char. 66: 0 > 1
Char. 149: 0 > 1
Char. 291: 0 > 1

Hemigrammus erythrozonus:
Char. 23: 0 > 1
Char. 66: 0 > 1
Char. 135: 0 > 1
Char. 139: 0 > 1
Char. 229: 0 > 1

Char. 311: 0 > 1
Char. 315: 0 > 1

Hollandichthys multifasciatus:
Char. 47: 1 > 0
Char. 61: 0 > 1
Char. 62: 0 > 2
Char. 184: 1 > 0
Char. 202: 0 > 1
Char. 256: 0 > 1
Char. 258: 1 > 0
Char. 358: 0 > 1

Hyphessobrycon elachys:
Char. 33: 0 > 1
Char. 73: 0 > 1
Char. 79: 0 > 1
Char. 192: 0 > 1
Char. 193: 0 > 1
Char. 201: 0 > 1
Char. 266: 1 > 0
Char. 268: 0 > 1
Char. 335: 1 > 0
Char. 339: 0 > 1
Char. 340: 0 > 2

Inpaichthys kerri:
Char. 10: 0 > 1
Char. 31: 0 > 1
Char. 49: 0 > 1
Char. 55: 0 > 1
Char. 164: 0 > 1
Char. 234: 1 > 0
Char. 307: 1 > 0
Char. 335: 1 > 0

Jupiaba mucronata:
Char. 306: 0 > 1

Jupiaba scologaster:
Char. 125: 0 > 1
Char. 184: 1 > 0
Char. 188: 0 > 1

Microschemobrycon casiquiare:
Char. 162: 0 > 1
Char. 196: 0 > 1

Moenkhausia dichroura:
Char. 127: 1 > 0

Char. 195: 1 > 0
Char. 231: 1 > 0

Moenkhausia cf. *intermedia*:
Char. 171: 0 > 1
Char. 235: 0 > 1
Char. 252: 1 > 0

Moenkhausia forestii:
Char. 92: 0 > 1
Char. 282: 1 > 0

Nantis indefessus:
Char. 315: 0 > 1

Nantis cf. *indefessus*:
Char. 79: 0 > 1

Nematobrycon palmeri:
Char. 53: 1 > 0
Char. 64: 1 > 0
Char. 91: 1 > 0
Char. 109: 0 > 1
Char. 136: 0 > 1
Char. 137: 0 > 1
Char. 172: 0 > 1
Char. 266: 1 > 0
Char. 288: 0 > 1
Char. 359: 0 > 1

Oligosarcus bolivianus:
No autapomorphies

Oligosarcus sp. n.:
Char. 88: 1 > 0

Oligosarcus cf. *jenynsii*:
Char. 76: 0 > 1
Char. 170: 0 > 1

Parecbasis cyclolepis:
Char. 53: 1 > 0
Char. 69: 1 > 0
Char. 82: 0 > 1
Char. 91: 1 > 0
Char. 107: 0 > 1
Char. 134: 1 > 0
Char. 135: 1 > 0
Char. 136: 1 > 0
Char. 172: 1 > 0
Char. 192: 0 > 1
Char. 195: 1 > 0
Char. 224: 0 > 1
Char. 229: 1 > 0
Char. 265: 1 > 0
Char. 282: 0 > 1
Char. 328: 0 > 1
Char. 339: 2 > 0
Char. 341: 0 > 1

Probolodus heterostomus:
Char. 67: 0 > 1
Char. 120: 0 > 1
Char. 122: 1 > 0
Char. 129: 1 > 0
Char. 253: 0 > 1
Char. 288: 0 > 1
Char. 306: 0 > 1

Psellogrammus kennedyi:
Char. 52: 1 > 0
Char. 69: 0 > 1
Char. 151: 0 > 1
Char. 294: 0 > 1
Char. 309: 1 > 0
Char. 317: 0 > 3
Char. 339: 0 > 1

Pseudochalceus kyburzi:
Char. 64: 1 > 0
Char. 201: 0 > 1
Char. 211: 0 > 1
Char. 250: 1 > 0
Char. 268: 0 > 1
Char. 307: 1 > 0

Roeboexodon geryi:
Char. 15: 0 > 1
Char. 26: 0 > 1
Char. 34: 0 > 1
Char. 64: 1 > 0
Char. 219: 0 > 1
Char. 234: 0 > 1

Salminus brasiliensis:
Char. 11: 0 > 1
Char. 13: 1 > 0
Char. 14: 1 > 0
Char. 47: 1 > 0
Char. 130: 0 > 1
Char. 168: 2 > 1
Char. 179: 0 > 1
Char. 181: 0 > 1
Char. 243: 1 > 0
Char. 266: 0 > 1
Char. 302: 0 > 1
Char. 336: 1 > 0
Char. 350: 1 > 0

Stichonodon insignis:
Char. 64: 1 > 0
Char. 82: 0 > 1
Char. 104: 0 > 1
Char. 133: 0 > 1
Char. 134: 1 > 0
Char. 148: 1 > 0
Char. 162: 0 > 1
Char. 179: 1 > 0
Char. 195: 1 > 0
Char. 224: 0 > 1
Char. 277: 0 > 1
Char. 322: 0 > 1
Char. 342: 1 > 0

Thayeria boehlkei:
Char. 79: 0 > 1

Thayeria obliqua:
Char. 21: 0 > 1
Char. 191: 0 > 1
Char. 219: 0 > 1
Char. 244: 0 > 1
Char. 266: 1 > 0

Triportheus nematurus:
No autapomorphies

Triportheus pantanensis:
Char. 228: 0 > 1

Astyanax altiparanae:
Char. 72: 0 > 1
Char. 74: 1 > 0

Astyanax jacuhiensis:
Char. 5: 0 > 1
Char. 21: 0 > 1
Char. 67: 0 > 1
Char. 110: 1 > 0

Char. 342: 1 > 0

Astyanax courensis:
Char. 342: 0 > 1

Astyanax goyanensis:
Char. 21: 0 > 1
Char. 47: 1 > 0
Char. 92: 1 > 0
Char. 110: 1 > 0
Char. 135: 0 > 1
Char. 253: 0 > 1
Char. 309: 1 > 0

Astyanax mexicanus:
Char. 67: 1 > 0
Char. 315: 0 > 1

Brittanichthys axelrodi:
Char. 2: 0 > 1
Char. 3: 1 > 0
Char. 48: 0 > 1
Char. 58: 0 > 1
Char. 84: 0 > 1
Char. 104: 1 > 0
Char. 133: 0 > 1
Char. 134: 1 > 0
Char. 141: 0 > 1
Char. 159: 0 > 1
Char. 165: 0 > 1
Char. 195: 1 > 0
Char. 201: 1 > 0
Char. 202: 0 > 1
Char. 235: 0 > 1
Char. 265: 1 > 0
Char. 309: 1 > 0
Char. 328: 0 > 1
Char. 347: 0 > 1
Char. 358: 0 > 1
Char. 359: 0 > 1
Char. 360: 0 > 1

Brycon pesu:
Char. 22: 0 > 1
Char. 41: 0 > 1
Char. 81: 1 > 0
Char. 195: 0 > 1
Char. 218: 0 > 1
Char. 227: 1 > 0
Char. 253: 1 > 0

Char. 324: 0 > 1

Bryconamericus iheringii:
Char. 21: 0 > 1
Char. 92: 1 > 0
Char. 104: 0 > 1
Char. 109: 1 > 0
Char. 151: 0 > 1
Char. 172: 1 > 0
Char. 306: 0 > 1
Char. 342: 0 > 1

Bryconamericus exodon:
Char. 172: 1 > 0
Char. 193: 1 > 0
Char. 345: 0 > 3

Bryconella pallidifrons:
Char. 8: 0 > 1
Char. 63: 0 > 1
Char. 109: 0 > 1
Char. 184: 1 > 0
Char. 341: 0 > 1

Bryconops alburnoides:
Char. 23: 1 > 0
Char. 62: 0 > 1
Char. 67: 1 > 0
Char. 109: 0 > 1
Char. 124: 0 > 1
Char. 134: 1 > 0
Char. 135: 1 > 0
Char. 151: 0 > 1
Char. 235: 0 > 1

Charax stenopterus:
Char. 64: 1 > 0
Char. 142: 0 > 1
Char. 325: 0 > 1

Cheirodon interruptus:
Char. 69: 0 > 1
Char. 135: 1 > 0
Char. 172: 1 > 0
Char. 192: 0 > 1
Char. 234: 1 > 0
Char. 258: 1 > 0
Char. 315: 0 > 1

Cheirodon jaguaribensis:

Char. 40: 1 > 0
Char. 320: 1 > 0

Cheirodon troemneri:
Char. 33: 0 > 1
Char. 66: 0 > 1
Char. 258: 1 > 0
Char. 287: 1 > 0

Cheirodon aff. *troemneri*:
Char. 48: 1 > 0
Char. 110: 0 > 1
Char. 139: 0 > 1
Char. 285: 1 > 0
Char. 307: 0 > 1

Coptobrycon bilineatus:
Char. 33: 0 > 1
Char. 134: 1 > 0
Char. 270: 1 > 0
Char. 285: 1 > 0
Char. 344: 0 > 1
Char. 347: 0 > 1

Cyanocharax alegretensis:
Char. 64: 0 > 1
Char. 92: 1 > 0
Char. 151: 0 > 1
Char. 201: 0 > 1
Char. 219: 0 > 1
Char. 235: 0 > 1
Char. 359: 1 > 0

Hasemania hanseni:
Char. 2: 0 > 1
Char. 38: 1 > 0
Char. 69: 1 > 0
Char. 104: 1 > 0
Char. 134: 1 > 0
Char. 148: 0 > 1
Char. 229: 0 > 1
Char. 307: 0 > 1

Hasemania kalunga:
Char. 110: 0 > 1
Char. 168: 1 > 2
Char. 196: 0 > 1
Char. 258: 1 > 0
Char. 356: 0 > 1

Hemigrammus bleheri:

Char. 21: 0 > 1
Char. 252: 0 > 1
Char. 309: 1 > 0
Char. 345: 0 > 1

Hemigrammus ocellifer:
Char. 109: 0 > 1
Char. 170: 1 > 0
Char. 196: 0 > 1
Char. 229: 0 > 1
Char. 234: 0 > 1
Char. 309: 1 > 0
Char. 342: 0 > 1
Char. 345: 0 > 3
Char. 348: 0 > 1

Hemigrammus parana:
Char. 38: 1 > 0
Char. 52: 1 > 0

Hemigrammus tocantinsi:
Char. 201: 0 > 1

Hemigrammus tridens:
Char. 38: 1 > 0
Char. 67: 1 > 0
Char. 196: 0 > 1
Char. 307: 0 > 1
Char. 328: 0 > 1
Char. 344: 0 > 1

Hemigrammus ulreyi:
Char. 315: 0 > 1

Hemigrammus unilineatus:
Char. 280: 0 > 1
Char. 339: 0 > 1
Char. 341: 1 > 0

Hyphessobrycon amandae:
Char. 38: 1 > 0
Char. 98: 0 > 12
Char. 134: 1 > 0
Char. 196: 0 > 1
Char. 343: 0 > 1

Hyphessobrycon anisitsi:
No autapomorphies

Hyphessobrycon axelrodi:
Char. 53: 1 > 0
Char. 62: 0 > 1
Char. 100: 1 > 0
Char. 266: 0 > 1
Char. 287: 0 > 1

Hyphessobrycon bentosi:
No autapomorphies

Hyphessobrycon bifasciatus:
Char. 21: 1 > 0

Hyphessobrycon boulengeri:
Char. 15: 0 > 1
Char. 62: 0 > 2
Char. 72: 0 > 1
Char. 73: 0 > 1
Char. 162: 0 > 1

Hyphessobrycon cachimbensis:
Char. 40: 1 > 0
Char. 139: 0 > 1

Hyphessobrycon compressus:
Char. 52: 1 > 0
Char. 53: 0 > 1
Char. 73: 0 > 1
Char. 309: 1 > 0
Char. 325: 0 > 1
Char. 341: 1 > 0

Hyphessobrycon copelandi:
Char. 109: 0 > 1

Hyphessobrycon ecuadoriensis:
Char. 40: 1 > 0
Char. 280: 0 > 1
Char. 339: 1 > 0
Char. 341: 0 > 1

Hyphessobrycon epicharis:
Char. 142: 0 > 1

Hyphessobrycon eques:
Char. 149: 0 > 1
Char. 234: 1 > 0

Hyphessobrycon erythrostigma:
Char. 109: 0 > 1
Char. 307: 0 > 1

Hyphessobrycon griemi:
Char. 63: 0 > 1
Char. 79: 0 > 1
Char. 100: 0 > 1
Char. 148: 0 > 1
Char. 282: 1 > 0
Char. 307: 1 > 0
Char. 320: 1 > 0
Char. 339: 0 > 1

Hyphessobrycon haraldschultzi:
Char. 21: 0 > 1
Char. 100: 0 > 1
Char. 362: 1 > 0
Char. 363: 1 > 0

Hyphessobrycon heliacus:
Char. 163: 0 > 1

Hyphessobrycon herbertaxelrodi:
Char. 148: 0 > 1
Char. 196: 0 > 1
Char. 201: 0 > 1
Char. 307: 1 > 0

Hyphessobrycon igneus:
Char. 73: 0 > 1
Char. 311: 0 > 1

Hyphessobrycon togoi:
Char. 100: 0 > 1
Char. 125: 0 > 1
Char. 234: 0 > 1
Char. 307: 1 > 0

Hyphessobrycon langeanii:
Char. 52: 1 > 0
Char. 98: 0 > 1
Char. 307: 1 > 0

Hyphessobrycon loweae:
Char. 40: 1 > 0
Char. 268: 0 > 1
Char. 282: 0 > 1

Hyphessobrycon megalopterus:

Char. 33: 0 > 1
Char. 66: 0 > 1
Char. 73: 0 > 1
Char. 79: 0 > 1
Char. 320: 1 > 0
Char. 345: 0 > 3

Hyphessobrycon meridionalis:
Char. 125: 0 > 1
Char. 234: 0 > 1
Char. 288: 0 > 1

Hyphessobrycon micropterus:
Char. 136: 1 > 0
Char. 163: 0 > 1

Hyphessobrycon minor:
Char. 170: 1 > 0

Hyphessobrycon moniliger:
Char. 16: 0 > 1
Char. 150: 0 > 1

Hyphessobrycon negodagua:
Char. 62: 0 > 2
Char. 345: 0 > 3
Char. 348: 0 > 1

Hyphessobrycon panamensis:
Char. 162: 0 > 1
Char. 201: 0 > 1

Hyphessobrycon parvellus:
Char. 170: 1 > 0
Char. 258: 1 > 0
Hyphessobrycon pulchripinnis:
Char. 69: 1 > 0
Char. 139: 0 > 1
Char. 339: 2 > 1

Hyphessobrycon pyrrhonotus:
Char. 104: 1 > 0
Char. 282: 0 > 1

Hyphessobrycon rosaceus:
Char. 170: 1 > 0

Hyphessobrycon rutiliflavidus:
Char. 139: 0 > 1
Char. 258: 1 > 0

Hyphessobrycon savagei:
Char. 148: 0 > 1
Char. 170: 1 > 0

Hyphessobrycon socolofi:
Char. 63: 0 > 1
Char. 67: 0 > 1
Char. 136: 0 > 1
Char. 195: 1 > 0
Char. 234: 1 > 0
Char. 307: 0 > 1
Char. 363: 0 > 1

Hyphessobrycon sweglesi:
Char. 52: 1 > 0
Char. 53: 0 > 1

Hyphessobrycon takasei:
Char. 52: 1 > 0
Char. 170: 1 > 0

Hyphessobrycon tortuguerae:
Char. 73: 0 > 1
Char. 104: 0 > 1
Char. 137: 0 > 1
Char. 280: 0 > 1

Ectrepopterus uruguayensis:
Char. 62: 0 > 2
Char. 73: 0 > 1
Char. 136: 0 > 1
Char. 168: 1 > 2
Char. 234: 1 > 0
Char. 345: 0 > 3

Hyphessobrycon werneri:
Char. 130: 0 > 1

Hyphessobrycon hasemani:
Char. 48: 1 > 0
Char. 62: 0 > 1
Char. 163: 0 > 1
Char. 288: 0 > 1

Jupiaba polylepis:
Char. 62: 0 > 2
Char. 64: 1 > 0
Char. 148: 0 > 1

Knodus meridae:
Char. 62: 1 > 02
Char. 309: 1 > 0

Knodus moenkhausii:
Char. 173: 0 > 1
Char. 313: 0 > 1
Char. 314: 0 > 1

Markiana nigripinnis:
Char. 54: 0 > 1
Char. 62: 0 > 1
Char. 64: 1 > 0
Char. 76: 0 > 1
Char. 81: 0 > 1
Char. 98: 1 > 2
Char. 100: 0 > 1
Char. 127: 0 > 1
Char. 129: 1 > 0
Char. 175: 0 > 1
Char. 176: 0 > 1
Char. 253: 0 > 1
Char. 254: 1 > 0
Char. 292: 0 > 1
Char. 306: 0 > 1
Char. 307: 1 > 0
Char. 318: 0 > 1
Char. 319: 0 > 1
Char. 320: 1 > 0
Char. 327: 0 > 1
Char. 328: 0 > 1
Char. 336: 1 > 0
Char. 341: 1 > 0
Char. 359: 0 > 1
Char. 363: 0 > 1

Microschemobrycon melanotus:
Char. 21: 1 > 0
Char. 62: 1 > 0
Char. 64: 0 > 1
Char. 100: 1 > 0
Char. 193: 1 > 0

Char. 202: 0 > 1
Char. 280: 0 > 1
Char. 343: 0 > 1

Moenkhausia hemigrammoides:
Char. 265: 1 > 0
Char. 343: 0 > 1

Moenkhausia pittieri:
Char. 21: 0 > 1
Char. 62: 0 > 2

Moenkhausia sanctaefilomenae:
Char. 170: 1 > 0
Char. 347: 0 > 1

Moenkhausia xinguensis:
Char. 64: 1 > 0
Char. 265: 1 > 0

Nematocharax venustus:
Char. 311: 0 > 1
Char. 328: 0 > 1

New genus:
Char. 15: 0 > 1
Char. 21: 0 > 1
Char. 107: 0 > 1
Char. 126: 1 > 0
Char. 129: 1 > 0
Char. 143: 1 > 0
Char. 252: 1 > 0

Cheirodon stenodon:
Char. 104: 0 > 1
Char. 136: 0 > 1
Char. 163: 0 > 1
Char. 201: 0 > 1
Char. 229: 0 > 1
Char. 234: 0 > 1
Char. 266: 1 > 0
Char. 314: 0 > 1
Char. 315: 0 > 1
Char. 320: 1 > 0
Char. 339: 0 > 1
Char. 341: 1 > 0
Char. 344: 0 > 1

Oligosarcus argenteus:
Char. 15: 0 > 1
Char. 21: 0 > 1
Char. 110: 1 > 0
Char. 137: 1 > 0
Char. 138: 1 > 0
Char. 154: 1 > 0
Char. 253: 1 > 0
Char. 306: 1 > 0

Paracheirodon axelrodi:
Char. 23: 0 > 1
Char. 48: 0 > 1
Char. 52: 0 > 1
Char. 79: 1 > 0
Char. 122: 1 > 0
Char. 139: 0 > 1

Paracheirodon innesi:
Char. 62: 0 > 1
Char. 73: 1 > 0
Char. 135: 0 > 1
Char. 180: 0 > 1
Char. 196: 0 > 1

Paracheirodon simulans:
Char. 13: 1 > 0
Char. 15: 0 > 1
Char. 47: 1 > 0
Char. 64: 1 > 0
Char. 138: 1 > 0
Char. 266: 0 > 1
Char. 280: 0 > 1
Char. 320: 1 > 0

Parapristella georgiae:
Char. 52: 1 > 0
Char. 67: 1 > 0
Char. 137: 0 > 1
Char. 138: 1 > 0
Char. 170: 1 > 0
Char. 202: 0 > 1
Char. 315: 0 > 1
Char. 328: 0 > 1
Char. 339: 0 > 1

Pristella maxillaris:
Char. 35: 1 > 0
Char. 64: 1 > 0
Char. 73: 0 > 1
Char. 82: 0 > 1
Char. 138: 1 > 0
Char. 155: 0 > 1
Char. 171: 0 > 1
Char. 315: 0 > 1
Char. 328: 0 > 1
Char. 335: 1 > 0

Moenkhausia sp. n.:
No autapomorphies

Deuterodon iguape:
No autapomorphies

Deuterodon langei:
Char. 53: 1 > 0
Char. 155: 0 > 1

Deuterodon longirostris:
No autapomorphies

Deuterodon singularis:
Char. 98: 0 > 1
Char. 103: 1 > 0
Char. 136: 1 > 0
Char. 188: 0 > 1
Char. 234: 1 > 0

Deuterodon stigmaturus:
Char. 94: 1 > 0
Char. 107: 0 > 1

Deuterodon supparis:
Char. 76: 0 > 1
Char. 94: 1 > 0
Char. 151: 1 > 0

Deuterodon rosae:
Char. 21: 0 > 1
Char. 98: 0 > 1
Char. 152: 0 > 1

Astyanax giton:
Char. 21: 0 > 1
Char. 100: 0 > 1
Char. 125: 1 > 0
Char. 148: 1 > 0
Char. 214: 0 > 1
Char. 309: 1 > 0
Char. 310: 1 > 0

Astyanax hastatus:
Char. 105: 0 > 1
Char. 168: 1 > 2
Char. 170: 1 > 0

Astyanax intermedius:
Char. 67: 0 > 1
Char. 98: 0 > 1
Char. 128: 0 > 1

Astyanax taeniatus:
Char. 170: 1 > 0
Char. 234: 0 > 1

Astyanax janeiroensis:
Char. 53: 0 > 1
Char. 148: 0 > 1
Char. 272: 0 > 1
Char. 280: 1 > 0

Astyanax jenynsii:
Char. 62: 0 > 1
Char. 287: 1 > 0

Astyanax parahybae:
Char. 341: 1 > 0
Char. 362: 1 > 0

Hyphessobrycon luetkenii:
Char. 91: 0 > 1

Astyanax ribeirae:
No autapomorphies

Node 241:
No synapomorphies

Node 242:
Char. 7: 1 > 0
Char. 11: 0 > 1
Char. 16: 0 > 1
Char. 20: 0 > 1
Char. 36: 0 > 1
Char. 41: 0 > 1
Char. 71: 0 > 1
Char. 96: 0 > 1
Char. 113: 0 > 1
Char. 163: 0 > 1
Char. 197: 0 > 1
Char. 230: 0 > 1
Char. 235: 0 > 1
Char. 242: 1 > 0
Char. 252: 1 > 0
Char. 259: 1 > 0
Char. 292: 0 > 1
Char. 349: 0 > 1

Node 243:
Char. 9: 0 > 1
Char. 182: 1 > 0
Char. 271: 0 > 1
Char. 306: 0 > 1

Node 244:
Char. 36: 3 > 0
Char. 168: 0 > 2
Char. 175: 1 > 0
Char. 222: 0 > 1
Char. 231: 1 > 0
Char. 260: 1 > 0
Char. 334: 0 > 1

Node 245:
Char. 205: 0 > 1
Char. 208: 0 > 1

Node 246:
Char. 143: 0 > 1
Char. 153: 1 > 0
Char. 168: 2 > 0
Char. 199: 0 > 1
Char. 207: 0 > 1
Char. 209: 1 > 0
Char. 336: 1 > 0
Char. 349: 0 > 2

Node 247:
Char. 21: 1 > 0
Char. 74: 0 > 1
Char. 76: 0 > 1
Char. 179: 0 > 1
Char. 297: 0 > 1

Node 248:
Char. 37: 1 > 0
Char. 38: 1 > 0
Char. 47: 0 > 1
Char. 64: 0 > 1
Char. 87: 0 > 1
Char. 143: 0 > 1
Char. 149: 0 > 1
Char. 159: 0 > 1
Char. 164: 0 > 1
Char. 183: 0 > 1
Char. 185: 1 > 0
Char. 230: 0 > 1
Char. 319: 0 > 1
Char. 321: 0 > 2
Char. 322: 1 > 0
Char. 338: 0 > 1
Char. 351: 0 > 1

Node 249:
Char. 171: 1 > 0
Char. 272: 1 > 0
Char. 279: 1 > 0
Char. 282: 1 > 0
Char. 294: 0 > 2
Char. 332: 1 > 0
Char. 335: 0 > 1

Node 250:
Char. 2: 1 > 0
Char. 3: 0 > 1
Char. 17: 0 > 1
Char. 37: 1 > 0
Char. 41: 0 > 1
Char. 70: 0 > 1
Char. 81: 1 > 0
Char. 130: 0 > 1
Char. 150: 0 > 1
Char. 157: 0 > 1
Char. 185: 1 > 0
Char. 190: 1 > 0
Char. 192: 1 > 0
Char. 238: 0 > 1
Char. 247: 0 > 1
Char. 273: 0 > 1
Char. 274: 0 > 1
Char. 281: 0 > 1
Char. 284: 0 > 1

Node 251:
Char. 56: 0 > 1
Char. 66: 0 > 1
Char. 105: 0 > 1
Char. 110: 1 > 0
Char. 143: 0 > 1

Char. 206: 0 > 1
Char. 248: 0 > 1
Char. 249: 0 > 1
Char. 255: 0 > 1
Char. 262: 0 > 1
Char. 319: 0 > 1

Node 252:
Char. 57: 1 > 0
Char. 89: 0 > 1
Char. 226: 0 > 1
Char. 264: 0 > 1
Char. 286: 0 > 1
Char. 287: 0 > 1
Char. 295: 1 > 0

Node 253:
Char. 8: 1 > 0
Char. 25: 0 > 1
Char. 100: 1 > 0
Char. 111: 0 > 1
Char. 242: 1 > 0
Char. 259: 1 > 0
Char. 266: 1 > 0
Char. 329: 0 > 1

Node 254:
Char. 7: 0 > 1
Char. 24: 1 > 0
Char. 34: 0 > 1
Char. 50: 0 > 1
Char. 68: 0 > 1
Char. 118: 1 > 0
Char. 121: 0 > 1
Char. 163: 0 > 1
Char. 165: 0 > 1
Char. 197: 0 > 2
Char. 211: 0 > 1
Char. 217: 0 > 1
Char. 283: 0 > 1
Char. 298: 1 > 0
Char. 320: 1 > 0

Node 255:
Char. 8: 0 > 1
Char. 81: 1 > 0
Char. 177: 0 > 1
Char. 189: 0 > 1
Char. 231: 0 > 1
Char. 274: 0 > 1

Node 256:
Char. 10: 1 > 0
Char. 62: 0 > 2
Char. 108: 1 > 0
Char. 110: 1 > 0
Char. 150: 0 > 1
Char. 154: 0 > 1
Char. 155: 0 > 1
Char. 200: 0 > 1
Char. 203: 1 > 0

Node 257:
Char. 7: 1 > 0
Char. 71: 0 > 1
Char. 74: 0 > 1
Char. 93: 0 > 1
Char. 136: 0 > 1
Char. 137: 0 > 1
Char. 183: 0 > 1
Char. 195: 1 > 0
Char. 199: 0 > 1
Char. 202: 0 > 1
Char. 253: 0 > 1

Node 258:
Char. 37: 1 > 0
Char. 47: 0 > 1
Char. 92: 0 > 1
Char. 227: 0 > 1
Char. 288: 0 > 1
Char. 305: 0 > 1
Char. 321: 0 > 2
Char. 322: 1 > 0
Char. 333: 1 > 0

Node 259:
Char. 14: 0 > 1
Char. 38: 1 > 0
Char. 192: 1 > 0
Char. 243: 0 > 1
Char. 271: 0 > 1
Char. 294: 2 > 0

Node 260:
Char. 10: 0 > 1
Char. 30: 0 > 1
Char. 98: 0 > 2
Char. 108: 0 > 1
Char. 220: 0 > 1
Char. 279: 0 > 1
Char. 306: 0 > 1

Node 261:
Char. 24: 1 > 0
Char. 34: 0 > 1
Char. 41: 0 > 1
Char. 70: 0 > 1
Char. 118: 1 > 0
Char. 135: 0 > 1
Char. 136: 0 > 1
Char. 300: 1 > 0
Char. 356: 0 > 1
Char. 361: 1 > 0
Char. 362: 1 > 0

Node 262:
Char. 53: 1 > 0
Char. 287: 0 > 1

Node 263:
Char. 36: 0 > 2
Char. 112: 0 > 1
Char. 126: 1 > 2
Char. 127: 1 > 0
Char. 153: 1 > 0
Char. 195: 1 > 0
Char. 331: 0 > 1

Node 264:
Char. 8: 0 > 1
Char. 30: 1 > 0
Char. 57: 0 > 1
Char. 94: 1 > 0
Char. 106: 0 > 1
Char. 162: 0 > 1
Char. 264: 1 > 0
Char. 276: 1 > 0
Char. 294: 0 > 1
Char. 298: 1 > 0
Char. 304: 0 > 1
Char. 330: 0 > 1

Node 265:
Char. 61: 1 > 0
Char. 82: 0 > 1
Char. 90: 0 > 1
Char. 157: 0 > 1
Char. 189: 0 > 1
Char. 287: 1 > 0

Char. 295: 0 > 1
Char. 297: 0 > 1
Char. 300: 1 > 0

Node 266:
Char. 66: 0 > 1
Char. 145: 0 > 1
Char. 275: 0 > 1
Char. 288: 0 > 1
Char. 330: 0 > 1
Char. 331: 0 > 1
Char. 365: 0 > 1

Node 267:
Char. 3: 0 > 1
Char. 53: 1 > 0
Char. 126: 1 > 0
Char. 131: 0 > 1
Char. 169: 0 > 1
Char. 170: 1 > 0
Char. 184: 1 > 0
Char. 199: 0 > 1
Char. 225: 0 > 1
Char. 278: 0 > 1
Char. 282: 0 > 1
Char. 298: 1 > 0
Char. 320: 1 > 0
Char. 325: 0 > 1
Char. 326: 0 > 1
Char. 327: 0 > 1
Char. 346: 0 > 1
Char. 363: 0 > 1
Char. 364: 0 > 1

Node 268:
Char. 69: 0 > 1
Char. 99: 1 > 0
Char. 115: 0 > 1
Char. 151: 0 > 1
Char. 152: 0 > 1
Char. 153: 1 > 0
Char. 158: 0 > 1
Char. 167: 0 > 1
Char. 192: 0 > 1
Char. 204: 1 > 0
Char. 279: 1 > 0
Char. 293: 0 > 1
Char. 320: 1 > 0
Char. 330: 0 > 1
Char. 331: 0 > 2
Char. 332: 0 > 1
Char. 349: 0 > 1

Node 269:
Char. 67: 0 > 1
Char. 143: 0 > 1
Char. 179: 0 > 1
Char. 218: 0 > 1
Char. 221: 1 > 0
Char. 234: 0 > 1

Node 270:
Char. 288: 1 > 0
Char. 327: 0 > 1

Node 271:
Char. 103: 1 > 0
Char. 123: 0 > 1
Char. 131: 0 > 1
Node 272:
Char. 243: 1 > 0

Node 273:
Char. 107: 0 > 1
Char. 345: 0 > 1

Node 274:
Char. 42: 0 > 1
Char. 102: 0 > 1
Char. 251: 0 > 1

Node 275:
Char. 12: 0 > 1
Char. 17: 0 > 1
Char. 37: 0 > 1
Char. 45: 0 > 1
Char. 50: 0 > 1
Char. 77: 0 > 1
Char. 78: 0 > 1
Char. 105: 0 > 1
Char. 244: 0 > 1
Char. 254: 1 > 0

Node 276:
Char. 35: 1 > 0
Char. 66: 0 > 1
Char. 258: 1 > 0

Node 277:
Char. 104: 0 > 1
Char. 122: 1 > 0
Char. 128: 0 > 1
Char. 229: 0 > 1
Char. 341: 1 > 0

Node 278:
Char. 10: 1 > 0
Char. 16: 0 > 1
Char. 62: 0 > 1
Char. 64: 1 > 0
Char. 136: 0 > 1
Char. 234: 0 > 1
Char. 266: 1 > 0
Char. 363: 0 > 1

Node 279:
Char. 53: 0 > 1
Char. 282: 1 > 0

Node 280:
Char. 67: 1 > 0
Char. 342: 1 > 0

Node 281:
Char. 98: 1 > 0
Char. 135: 0 > 1

Node 282:
Char. 109: 1 > 0

Node 283:
Char. 69: 0 > 1

Node 284:
Char. 91: 0 > 1
Char. 92: 1 > 0

Node 285:
Char. 135: 1 > 0
Char. 148: 1 > 0

Node 286:
Char. 288: 1 > 0

Node 287:
Char. 306: 1 > 0
Char. 350: 1 > 0

Node 288:
Char. 23: 1 > 0

Char. 38: 0 > 1

Node 289:
Char. 81: 1 > 0
Char. 178: 0 > 1
Char. 185: 1 > 0
Char. 234: 1 > 0
Char. 239: 1 > 0
Char. 250: 0 > 1
Char. 266: 0 > 1
Char. 279: 1 > 0
Char. 341: 0 > 1
Char. 342: 0 > 1

Node 290:
Char. 2: 1 > 0
Char. 3: 0 > 1
Char. 39: 1 > 0
Char. 46: 0 > 1
Char. 53: 1 > 0
Char. 61: 1 > 0
Char. 70: 0 > 1
Char. 168: 2 > 1
Char. 227: 1 > 0
Char. 243: 1 > 0
Char. 254: 0 > 1

Node 291:
Char. 108: 1 > 0
Char. 148: 0 > 1
Char. 319: 0 > 1

Node 292:
Char. 47: 1 > 0
Char. 53: 1 > 0
Char. 66: 1 > 0
Char. 281: 0 > 1
Char. 289: 0 > 1
Char. 307: 1 > 0

Node 293:
Char. 58: 0 > 1
Char. 137: 0 > 1
Char. 186: 0 > 1
Char. 284: 0 > 1
Char. 288: 0 > 1
Char. 294: 0 > 1
Char. 350: 0 > 1

Node 294:
Char. 95: 0 > 1
Char. 96: 0 > 1
Char. 114: 0 > 1
Char. 152: 0 > 1
Char. 227: 0 > 1
Char. 330: 0 > 1

Node 295:
Char. 3: 1 > 0
Char. 45: 1 > 0
Char. 116: 0 > 1
Char. 181: 0 > 1
Char. 193: 0 > 1
Char. 317: 0 > 2
Char. 350: 0 > 1

Node 296:
Char. 69: 1 > 0
Char. 76: 0 > 1
Char. 91: 1 > 0
Char. 92: 0 > 1
Char. 161: 0 > 1

Node 297:
Char. 11: 0 > 1
Char. 18: 1 > 0
Char. 80: 0 > 1
Char. 118: 1 > 0
Char. 149: 0 > 1
Char. 150: 0 > 1
Char. 179: 1 > 0
Char. 211: 0 > 1
Char. 216: 0 > 1
Char. 232: 0 > 1
Char. 233: 0 > 1
Char. 253: 0 > 1
Char. 280: 1 > 0
Char. 332: 0 > 1
Char. 333: 0 > 1

Node 298:
Char. 45: 0 > 1
Char. 48: 1 > 0
Char. 163: 0 > 1
Char. 200: 0 > 1
Char. 214: 0 > 1
Char. 221: 0 > 1
Char. 229: 0 > 1
Char. 284: 0 > 1
Char. 289: 0 > 1
Char. 339: 0 > 2

Node 299:
Char. 62: 0 > 2
Char. 138: 1 > 0

Node 300:
Char. 23: 0 > 1
Char. 196: 0 > 1

Node 301:
Char. 136: 0 > 1
Char. 137: 0 > 1
Char. 154: 0 > 1
Char. 155: 0 > 1
Char. 288: 0 > 1

Node 302:
Char. 21: 1 > 0
Char. 48: 0 > 1

Node 303:
Char. 198: 0 > 1
Char. 339: 2 > 1

Node 304:
Char. 93: 0 > 1
Char. 183: 0 > 1
Char. 202: 0 > 1

Node 305:
Char. 8: 0 > 1
Char. 45: 0 > 1
Char. 118: 1 > 0
Char. 136: 0 > 1
Char. 137: 0 > 1
Char. 138: 1 > 0
Char. 143: 1 > 0
Char. 154: 0 > 1
Char. 163: 0 > 1
Char. 174: 1 > 0
Char. 189: 0 > 1
Char. 223: 0 > 1
Char. 306: 1 > 0
Char. 339: 0 > 2
Char. 344: 0 > 1

Node 306:
Char. 7: 1 > 0
Char. 10: 0 > 1

Char. 66: 0 > 1
Char. 74: 0 > 1
Char. 117: 0 > 1
Char. 120: 0 > 1
Char. 294: 0 > 1

Node 307:
Char. 40: 0 > 1
Char. 267: 0 > 1
Node 308:
Char. 51: 0 > 1
Char. 98: 1 > 0
Char. 258: 1 > 0

Node 309:
Char. 52: 1 > 0
Char. 69: 0 > 1
Char. 147: 0 > 1
Char. 280: 1 > 0
Char. 294: 0 > 1
Char. 327: 0 > 1
Char. 328: 0 > 1

Node 310:
Char. 27: 0 > 1
Char. 28: 0 > 1
Char. 64: 1 > 0
Char. 66: 0 > 1
Char. 101: 0 > 1
Char. 104: 0 > 1
Char. 128: 0 > 1
Char. 141: 0 > 1
Char. 151: 1 > 0
Char. 193: 0 > 1
Char. 253: 0 > 1

Node 311:
Char. 139: 0 > 1
Char. 140: 0 > 1
Char. 268: 0 > 1

Node 312:
Char. 149: 0 > 1
Char. 180: 0 > 1

Node 313:
Char. 69: 1 > 0
Char. 97: 0 > 1
Char. 119: 0 > 1
Char. 136: 1 > 0
Char. 269: 0 > 1
Char. 314: 0 > 1
Node 314:
Char. 91: 1 > 0
Char. 107: 0 > 1
Char. 162: 0 > 1
Char. 164: 0 > 1
Char. 257: 0 > 1
Char. 266: 0 > 1

Node 315:
Char. 27: 0 > 1
Char. 100: 0 > 1
Char. 339: 0 > 2

Node 316:
Char. 82: 0 > 1
Char. 335: 1 > 0

Node 317:
Char. 91: 0 > 1
Char. 92: 1 > 0
Char. 257: 1 > 0
Char. 269: 1 > 0
Char. 301: 0 > 1
Char. 302: 0 > 1
Char. 303: 0 > 1
Char. 313: 0 > 1

Node 318:
Char. 129: 0 > 1
Char. 270: 0 > 1

Node 319:
Char. 247: 0 > 1
Char. 284: 0 > 1
Char. 352: 1 > 0

Node 320:
Char. 193: 1 > 0
Char. 353: 0 > 1
Char. 354: 0 > 1
Char. 358: 0 > 1

Node 321:
Char. 288: 0 > 1

Node 322:
Char. 313: 0 > 1
Char. 314: 0 > 1

Node 323:
Char. 44: 0 > 1
Char. 162: 0 > 1
Char. 193: 0 > 1
Char. 250: 1 > 0
Node 324:
Char. 21: 1 > 0
Char. 31: 0 > 1
Char. 84: 0 > 1
Char. 91: 1 > 0
Char. 109: 0 > 1
Char. 110: 0 > 1
Char. 129: 1 > 0
Char. 151: 1 > 0
Char. 270: 1 > 0
Char. 276: 1 > 0
Char. 359: 0 > 1

Node 325:
Char. 92: 1 > 0
Char. 188: 0 > 1
Char. 283: 0 > 1

Node 326:
Char. 77: 0 > 1
Char. 104: 0 > 1
Char. 192: 0 > 1
Char. 287: 1 > 0

Node 327:
Char. 108: 0 > 1

Node 328:
Char. 139: 0 > 1
Char. 192: 0 > 1

Node 329:
Char. 330: 0 > 1

Node 330:
Char. 229: 0 > 1

Node 331:
Char. 124: 0 > 1
Char. 139: 1 > 0
Char. 192: 1 > 0
Char. 235: 0 > 1
Char. 252: 1 > 0

Node 332:

Char. 311: 0 > 1

Node 333:
Char. 330: 0 > 1

Node 334:
Char. 350: 0 > 1

Node 335:
Char. 352: 1 > 0
Node 336:
Char. 67: 1 > 0
Char. 148: 1 > 0
Char. 253: 0 > 1

Node 337:
Char. 152: 0 > 1
Char. 204: 1 > 0
Char. 245: 0 > 1
Char. 285: 1 > 0
Char. 302: 0 > 1

Node 338:
Char. 26: 0 > 1
Char. 84: 1 > 0
Char. 104: 1 > 0
Char. 108: 0 > 1
Char. 193: 1 > 0
Char. 235: 0 > 1
Char. 331: 0 > 1

Node 339:
Char. 31: 1 > 0

Node 340:
Char. 96: 0 > 1

Node 341:
Char. 148: 0 > 1
Char. 173: 0 > 1
Char. 288: 0 > 1

Node 342:
Char. 21: 0 > 1
Char. 31: 1 > 0
Char. 92: 1 > 0
Char. 328: 0 > 1

Node 343:
Char. 21: 0 > 1
Char. 122: 1 > 0
Char. 128: 0 > 1

Node 344:
Char. 43: 0 > 1
Char. 196: 0 > 1
Char. 214: 0 > 1

Node 345:
Char. 280: 1 > 0
Node 346:
Char. 16: 1 > 0
Char. 130: 0 > 1
Char. 138: 1 > 0
Char. 142: 0 > 1

Node 347:
Char. 350: 0 > 1

Node 348:
Char. 289: 1 > 0
Char. 342: 0 > 1

Node 349:
Char. 47: 1 > 0
Char. 67: 1 > 0
Char. 74: 0 > 1

Node 350:
Char. 134: 1 > 0

Node 351:
Char. 108: 0 > 1
Char. 289: 0 > 1
Char. 319: 1 > 0
Char. 330: 0 > 1

Node 352:
Char. 280: 1 > 0
Char. 288: 0 > 1
Char. 357: 0 > 1
Node 353:
Char. 127: 1 > 0
Char. 342: 1 > 0

Node 354:
Char. 310: 0 > 1
Char. 311: 0 > 1
Char. 312: 0 > 1

Node 355:
Char. 310: 0 > 1
Char. 311: 0 > 1
Char. 312: 0 > 1

Node 356:
Char. 74: 0 > 1

Node 357:
Char. 202: 0 > 1
Node 358:
Char. 330: 0 > 1

Node 359:
Char. 125: 0 > 1
Char. 188: 0 > 1

Node 360:
Char. 23: 0 > 1

Node 361:
Char. 151: 1 > 0
Char. 322: 0 > 1

Node 362:
Char. 23: 0 > 1
Char. 38: 1 > 0
Char. 67: 0 > 1
Char. 306: 0 > 1
Char. 359: 0 > 1

Node 363:
Char. 91: 1 > 0
Char. 104: 1 > 0

Node 364:
Char. 328: 0 > 1

Node 365:
Char. 280: 1 > 0
Char. 307: 1 > 0
Char. 314: 0 > 1
Char. 315: 0 > 1
Char. 316: 0 > 2
Node 366:
Char. 104: 0 > 1

Node 367:
Char. 310: 0 > 1

Node 368:
Char. 311: 0 > 1
Char. 312: 0 > 1

Node 369:
Char. 40: 0 > 1
Char. 234: 0 > 1

Node 370:
Char. 5: 0 > 1
Char. 136: 0 > 1
Char. 137: 0 > 1
Char. 154: 0 > 1
Char. 202: 0 > 1

Node 371:
Char. 74: 0 > 1
Char. 143: 1 > 0
Char. 193: 0 > 1
Char. 306: 0 > 1

Node 372:
Char. 59: 0 > 1
Char. 69: 1 > 0
Char. 91: 1 > 0
Char. 120: 0 > 1
Char. 288: 1 > 0

Node 373:
Char. 202: 0 > 1
Char. 302: 0 > 1

Node 374:
Char. 60: 0 > 1
Char. 72: 0 > 1
Char. 74: 0 > 1
Char. 92: 1 > 0
Char. 183: 0 > 1
Char. 265: 1 > 0

Node 375:
Char. 21: 1 > 0
Char. 281: 0 > 1
Char. 325: 0 > 1
Char. 339: 1 > 0

Node 376:
Char. 16: 0 > 1
Char. 47: 1 > 0
Char. 128: 0 > 1
Char. 241: 0 > 1
Char. 258: 1 > 0

Node 377:
Char. 52: 0 > 1
Char. 129: 1 > 0
Char. 193: 0 > 1

Node 378:
Char. 110: 0 > 1

Node 379:
Char. 280: 0 > 1
Char. 356: 0 > 1

Node 380:
Char. 135: 1 > 0

Node 381:
Char. 52: 1 > 0
Char. 201: 0 > 1
Char. 339: 0 > 1

Node 382:
Char. 21: 0 > 1
Char. 73: 0 > 1
Char. 104: 0 > 1

Node 383:
Char. 53: 0 > 1
Char. 307: 1 > 0

Node 384:
Char. 282: 1 > 0

Node 385:
Char. 67: 0 > 1
Char. 280: 1 > 0

Node 386:
Char. 135: 1 > 0
Char. 151: 0 > 1
Char. 325: 0 > 1

Node 387:
Char. 229: 0 > 1
Char. 258: 1 > 0

Node 388:
Char. 135: 1 > 0
Char. 171: 0 > 1
Char. 252: 1 > 0
Char. 287: 1 > 0

Node 389:
Char. 104: 0 > 1
Char. 128: 0 > 1
Char. 307: 0 > 1

Node 390:
Char. 110: 0 > 1
Char. 328: 0 > 1

Node 391:
Char. 66: 0 > 1
Char. 150: 0 > 1
Char. 230: 0 > 1
Char. 253: 0 > 1
Char. 341: 1 > 0

Node 392:
Char. 23: 0 > 1
Char. 185: 0 > 1

Node 393:
Char. 38: 1 > 0
Char. 91: 1 > 0
Char. 92: 0 > 1
Char. 104: 1 > 0
Char. 139: 0 > 1
Char. 151: 1 > 0
Char. 234: 1 > 0

Node 394:
Char. 67: 0 > 1
Char. 263: 0 > 1

Node 395:
Char. 202: 0 > 1

Node 396:
Char. 84: 0 > 1
Char. 322: 0 > 1

Node 397:
Char. 48: 0 > 1
Char. 219: 0 > 1

Node 398:
Char. 193: 0 > 1
Char. 224: 0 > 1

Char. 345: 0 > 3

Node 399:
Char. 53: 0 > 1
Char. 64: 1 > 0
Char. 148: 0 > 1
Char. 234: 1 > 0
Char. 321: 2 > 1

Node 400:
Char. 196: 0 > 1
Char. 322: 0 > 1
Char. 328: 0 > 1

Node 401:
Char. 47: 1 > 0
Char. 64: 0 > 1
Char. 92: 1 > 0
Char. 109: 1 > 0
Char. 129: 0 > 1
Char. 151: 0 > 1
Char. 234: 1 > 0
Char. 330: 1 > 0

Node 402:
Char. 12: 0 > 1
Char. 150: 0 > 1
Char. 282: 1 > 0
Char. 314: 0 > 1

Node 403:
Char. 80: 0 > 1
Char. 121: 0 > 1
Char. 148: 0 > 1
Char. 200: 0 > 1

Node 404:
Char. 62: 0 > 2
Char. 159: 0 > 1
Char. 170: 1 > 0
Char. 176: 0 > 1
Char. 288: 1 > 0

Node 405:
Char. 148: 0 > 1
Char. 231: 1 > 0
Char. 345: 0 > 2

Node 406:
Char. 3: 0 > 1
Char. 39: 1 > 0
Char. 56: 0 > 1
Char. 60: 0 > 1
Char. 61: 1 > 0
Char. 64: 1 > 0
Char. 67: 0 > 1
Char. 74: 1 > 0
Char. 85: 0 > 1
Char. 127: 1 > 0
Char. 136: 1 > 0
Char. 137: 1 > 0
Char. 151: 0 > 1
Char. 166: 0 > 1
Char. 172: 0 > 1
Char. 175: 0 > 1
Char. 185: 1 > 0
Char. 189: 0 > 1
Char. 190: 1 > 0
Char. 202: 1 > 0
Char. 215: 0 > 1
Char. 219: 0 > 1
Char. 223: 0 > 1
Char. 227: 1 > 0
Char. 231: 0 > 1
Char. 236: 0 > 1
Char. 237: 0 > 1
Char. 238: 0 > 1
Char. 248: 0 > 1
Char. 249: 0 > 1
Char. 258: 1 > 0
Char. 261: 0 > 1
Char. 262: 0 > 1
Char. 274: 0 > 1
Char. 319: 0 > 1
Char. 321: 2 > 0
Char. 322: 0 > 1

Node 407:
Char. 72: 0 > 1
Char. 168: 1 > 2
Char. 287: 1 > 0
Char. 347: 0 > 1

Node 408:
Char. 118: 1 > 0
Char. 142: 0 > 1
Char. 343: 0 > 1

Node 409:
Char. 290: 0 > 1

Node 410:
Char. 266: 1 > 0
Char. 320: 0 > 1

Node 411:
Char. 66: 0 > 1
Char. 79: 0 > 1

Node 412:
Char. 21: 1 > 0
Char. 100: 0 > 1
Char. 168: 1 > 2

Node 413:
Char. 48: 1 > 0
Char. 320: 1 > 0

Node 414:
Char. 235: 0 > 1

Node 415:
Char. 16: 0 > 1
Char. 58: 0 > 1
Char. 100: 0 > 1
Char. 122: 1 > 0
Char. 168: 1 > 2
Char. 234: 1 > 0
Char. 320: 1 > 0
Char. 341: 1 > 0

Node 416:
Char. 282: 1 > 0

Node 417:
Char. 229: 0 > 1
Char. 288: 0 > 1
Char. 339: 0 > 2
Char. 343: 0 > 1

Node 418:
Char. 270: 1 > 0
Char. 276: 1 > 0

Node 419:
Char. 63: 0 > 1

Node 420:
Char. 38: 1 > 0
Char. 48: 0 > 1
Char. 148: 0 > 1

Char. 168: 1 > 2
Char. 328: 0 > 1

Node 421:
Char. 38: 1 > 0
Char. 282: 0 > 1
Char. 328: 0 > 1

Node 422:
Char. 343: 0 > 1
Node 423:
Char. 136: 0 > 1

Node 424:
Char. 229: 0 > 1

Node 425:
Char. 52: 0 > 1
Char. 234: 1 > 0
Char. 258: 1 > 0
Char. 315: 0 > 1
Char. 320: 1 > 0

Node 426:
Char. 168: 1 > 2

Node 427:
Char. 307: 1 > 0
Node 428:
Char. 202: 0 > 1
Char. 339: 0 > 2

Node 429:
Char. 40: 1 > 0
Char. 104: 0 > 1

Node 430:
Char. 288: 0 > 1
Char. 309: 1 > 0

Node 431:
Char. 170: 1 > 0
Char. 347: 0 > 1

Node 432:
Char. 136: 1 > 0
Char. 139: 0 > 1

Node 433:
Char. 130: 0 > 1

Node 434:
Char. 40: 0 > 1
Char. 268: 0 > 1

Node 435:
Char. 40: 0 > 1

Node 436:
Char. 148: 0 > 1
Char. 342: 0 > 1

Node 437:
Char. 73: 0 > 1
Char. 258: 1 > 0

Node 438:
Char. 168: 1 > 2

Node 439:
Char. 348: 0 > 1

Node 440:
Char. 53: 0 > 1

Node 441:
Char. 21: 0 > 1
Char. 309: 1 > 0
Char. 342: 0 > 1

Node 442:
Char. 342: 0 > 1

Node 443:
Char. 109: 0 > 1

Node 444:
Char. 168: 1 > 2

Node 445:
Char. 64: 0 > 1
Char. 172: 1 > 0

Node 446:
Char. 6: 0 > 1
Char. 128: 0 > 1
Char. 285: 1 > 0 Char. 340: 0 > 2

Node 447:
Char. 33: 0 > 1

Node 448:
Char. 149: 1 > 0
Char. 266: 1 > 0

Node 449:
Char. 162: 0 > 1

Node 450:
Char. 97: 0 > 1

Node 451:
Char. 96: 0 > 1
Char. 136: 0 > 1
Char. 307: 1 > 0

Node 452:
Char. 38: 1 > 0
Char. 74: 0 > 1
Char. 92: 0 > 1
Char. 125: 0 > 1
Char. 139: 0 > 1

Node 453:
Char. 73: 0 > 1

Node 454:
Char. 272: 0 > 1

Node 455:
Char. 148: 0 > 1
Char. 163: 0 > 1
Char. 253: 0 > 1

Node 456:
Char. 40: 1 > 0
Char. 234: 1 > 0
Char. 252: 1 > 0

Node 457:
Char. 152: 0 > 1
Char. 272: 0 > 1

Node 458:
Char. 73: 0 > 1
Char. 218: 1 > 0

Appendix IV. List of transitions and total number of steps for each character. The number of the clades correspond to the IW strict consensus cladrogram.

Char. 0 (0 step)
Root: ?
Char. 1 (4 steps)
Root: 0
Piabucus melanostomus: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Node 297: 0 > 01
Node 306: 01 > 1
Acestrocephalus sardina: 01 > 0
Cynopotamus argenteus: 01 > 1
Char. 2 (5 steps)
Root: 1
Node 250: 1 > 0
Serrasalmus maculatus: 1 > 0
Node 290: 1 > 0
Hasemania hanseni: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 3 (9 steps)
Root: 0
Node 267: 0 > 1
Node 250: 0 > 1
Cyphocharax spilotus: 0 > 1
Micralestes stormsi: 0 > 1
Node 290: 0 > 1
Node 406: 0 > 1
Rhoadsia altipinna: 1 > 0
Node 295: 1 > 0
Brittanichthys axelrodi: 1 > 0
Char. 4 (1 step)
Root: 1
Pyrrhulina australis: 1 > 0
Hasemania nana: 1 > 01
Char. 5 (2 steps)
Root: 0
Node 370: 0 > 1
Astyanax jacuhiensis: 0 > 1
Char. 6 (2 steps)
Root: 0
Hyphessobrycon elachys: 0 > 01
Node 446: 0 > 1
Grundulus cochae: 0 > 1
Char. 7 (5 steps)
Root: 1
Node 242: 1 > 0
Node 257: 1 > 0
Brycon meeki: 0 > 01
Node 262: 1 > 01
Brycon pesu: 0 > 01
Brycon falcatus: 0 > 01
Node 254: 0 > 1
Bryconaethiops macrops: 01 > 0
Markiana nigripinnis: 1 > 01
Hemibrycon dariensis: 1 > 01
Bryconexodon juruenae: 1 > 01
Node 306: 1 > 0
Cynopotamus argenteus: 1 > 01
Moenkhausia xinguensis: 1 > 01
Char. 8 (8 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Node 253: 1 > 0
Node 246: 1 > 01
Leporinus striatus: 01 > 0
Prochilodus lineatus: 01 > 0
Cyphocharax spilotus: 01 > 1
Node 264: 0 > 1
Node 255: 0 > 1
Node 305: 0 > 1
Acestrorhynchus pantaneiro: 1 > 01
Bryconella pallidifrons: 0 > 1
Char. 9 (3 steps)
Root: 0
Node 243: 0 > 1
Node 265: 0 > 01
Node 264: 01 > 1
Agoniates anchovia: 0 > 1
Char. 10 (12 steps)
Root: 0
Puntius tetrazona: 0 > 01
Distichodus maculatus: 0 > 01
Node 260: 0 > 1
Prochilodus lineatus: 0 > 1
Node 256: 1 > 0
Acestrorhynchus pantaneiro: 0 > 01
Astyanax goyanensis: 1 > 01
Oligosarcus bolivianus: 1 > 01
Hyphessobrycon griemi: 1 > 01
Node 278: 1 > 0
Node 300: 1 > 01
Astyanax altiparanae: 1 > 01
Astyanax lineatus: 1 > 01
Probolodus heterostomus: 1 > 01
Node 299: 01 > 0
Hollandichthys multifasciatus: 1 > 01
Nematocharax venustus: 01 > 1
Inpaichthys kerri: 0 > 1
Cyanocharax alburnus: 0 > 01
Hemibrycon dariensis: 0 > 01
Rhoadsia altipinna: 01 > 0
Aphyodite grammica: 0 > 1
Exodon paradoxus: 0 > 01
Bryconamericus iheringii: 0 > 01
Cyanocharax alegretensis: 0 > 01
Node 306: 0 > 1
Parecbasis cyclolepis: 0 > 01
Axelrodia lindeae: 0 > 01
Aphyocharacidium bolivianum: 0 > 01
Node 342: 0 > 01
Cheirodon jaguaribensis: 1 > 01
Hemigrammus bleheri: 1 > 01
Thayeria obliqua: 1 > 01
Node 445: 01 > 1
Bryconamericus alpha: 0 > 01
Cheirodon interruptus: 0 > 01
Bryconamericus exodon: 0 > 01
Mimagoniates rheocharis: 0 > 01
Node 377: 1 > 01
Node 376: 01 > 0
Aulixidens eugeniae: 0 > 01
Odontostoechus lethostigmus: 0 > 01
Creagrutus anary: 0 > 1
Paracheirodon simulans: 1 > 01
Char. 11 (6 steps)
Root: 0
Node 242: 0 > 1
Serrasalmus maculatus: 0 > 1
Salminus brasiliensis: 0 > 1
Acestrorhynchus pantaneiro: 0 > 1
Hollandichthys multifasciatus: 0 > 01
Node 297: 0 > 1
Bryconexodon juruenae: 0 > 01
Piabina argentea: 0 > 1
Char. 12 (7 steps)
Root: 0
Acestrorhynchus pantaneiro: 0 > 1
Node 402: 0 > 1
Node 275: 0 > 1
Attonitus ephimeros: 0 > 1
Paragoniates alburnus: 1 > 0
Cynopotamus argenteus: 0 > 1
Gymnocharacinus bergii: 0 > 1
Char. 13 (6 steps)
Root: 1
Brycon meeki: 1 > 0
Salminus brasiliensis: 1 > 0
Brycon falcatus: 1 > 01
Node 404: 1 > 01
Oligosarcus sp. n.: 01 > 0
Oligosarcus argenteus: 01 > 1
Node 402: 01 > 0
Astyanax troya: 1 > 01
Markiana nigripinnis: 1 > 01
Bryconexodon juruenae: 1 > 0
Piabina argentea: 1 > 01
Paracheirodon simulans: 1 > 0
Char. 14 (6 steps)
Root: 0
Distichodus maculatus: 0 > 1
Hemiodus cf. *thayeria*: 0 > 1
Node 259: 0 > 1
Salminus brasiliensis: 1 > 0
Rhaphiodon vulpinus: 1 > 0
Aulixidens eugeniae: 1 > 0
Char. 15 (7 steps)
Root: 01
Node 259: 01 > 0
Node 267: 01 > 1
Hyphessobrycon anisitsi: 0 > 01
Oligosarcus argenteus: 0 > 1
Hyphessobrycon togoi: 0 > 01
Hyphessobrycon igneus: 0 > 01
Markiana nigripinnis: 0 > 01
Hasemania kalunga: 0 > 01
Hyphessobrycon boulengeri: 0 > 1
Roeboexodon geryi: 0 > 1
Hyphessobrycon rutiliflavidus: 0 > 01
Roeboides descalvadensis: 0 > 1
Hyphessobrycon pulchripinnis: 0 > 01
Hyphessobrycon negodagua: 0 > 01
Knodus meridae: 0 > 01
Moenkhausia xinguensis: 0 > 01
Hyphessobrycon pyrrhonotus: 0 > 01
Paracheirodon axelrodi: 0 > 01
Paracheirodon simulans: 0 > 1
New Genus: 0 > 1
Char. 16 (8 steps)
Root: 0
Node 242: 0 > 1
Node 251: 0 > 01
Node 250: 01 > 1
Bryconamericus scleroparius: 0 > 1
Node 278: 0 > 1
Node 346: 1 > 0
Prodontocharax melanotus: 1 > 01
Hyphessobrycon moniliger: 0 > 1
Node 415: 0 > 1
Node 376: 0 > 1
Char. 17 (2 steps)
Root: 0
Node 250: 0 > 1
Node 275: 0 > 1
Char. 18 (3 steps)
Root: 1
Node 251: 1 > 01
Node 250: 01 > 0
Node 256: 1 > 01
Node 255: 01 > 0
Oligosarcus cf. *jenynsii*: 1 > 01
Node 297: 1 > 0
Hyphessobrycon luetkenii: 1 > 01
Gymnocharacinus bergii: 1 > 01
Paracheirodon innesi: 1 > 01
Char. 19 (1 steps)
Root: 0
Aphyocharax anisitsi: 0 > 1
Char. 20 (2 steps)
Root: 0
Puntius tetrazona: 0 > 01
Node 242: 0 > 1
Leporinus striatus: 0 > 1
Char. 21 (41 steps)
Root: 1
Puntius tetrazona: 1 > 01
Distichodus maculatus: 1 > 01

Node 247: 1 > 0
Engraulisoma taeniatum: 1 > 01
Node 258: 1 > 01
Piaractus mesopotamicus: 1 > 01
Metynnis maculatus: 1 > 0
Node 291: 01 > 0
Iguanodectes geisleri: 01 > 1
Brycon meeki: 01 > 0
Salminus brasiliensis: 01 > 1
Node 255: 01 > 0
Brycon pesu: 01 > 1
Brycon falcatus: 01 > 0
Node 406: 01 > 1
Brycon orbignyanus: 01 > 0
Hoplocharax goethei: 0 > 01
Acestrorhynchus pantaneiro: 0 > 01
Bryconamericus scleroparius: 0 > 1
Node 284: 0 > 01
Node 283: 01 > 1
Astyanax mexicanus: 0 > 01
Oligosarcus argenteus: 0 > 1
Astyanax goyanensis: 0 > 1
Oligosarcus cf. *jenynsii*: 0 > 01
Hyphessobrycon bifasciatus: 1 > 0
Node 302: 1 > 0
Node 324: 1 > 0
Astyanax jacuhiensis: 0 > 1
Node 441: 0 > 1
Moenkhausia pittieri: 0 > 1
Moenkhausia hemigrammoides: 0 > 01
Pseudochalceus kyburzi: 0 > 01
Hyphessobrycon boulengeri: 1 > 01
Moenkhausia sanctaefilomenae: 0 > 01
Node 382: 0 > 1
Rhoadsia altipinna: 0 > 01
Carlana eigenmanni: 0 > 01
Aphyodite grammica: 1 > 0
Exodon paradoxus: 0 > 1
Aphyocharax nattereri: 1 > 0
Bryconamericus iheringii: 0 > 1
Attonitus ephimeros: 0 > 01
Node 417: 0 > 01
Axelrodia lindeae: 1 > 0
Node 342: 0 > 1
Astyanax giton: 0 > 1
Deuterodon rosae: 0 > 1
Moenkhausia sp. n.: 0 > 01
Cheirodon jaguaribensis: 0 > 01
Node 416: 01 > 1
Hemigrammus unilineatus: 0 > 01
Hyphessobrycon rutiliflavidus: 0 > 01
Hemigrammus bleheri: 0 > 1
Thayeria obliqua: 0 > 1
Acestrocephalus sardina: 0 > 01
Microschemobrycon melanotus: 1 > 0
Phenagoniates macrolepis: 1 > 01
Bryconamericus alpha: 0 > 01
Deuterodon iguape: 0 > 01
Hyphessobrycon socolofi: 01 > 0
Hyphessobrycon pulchripinnis: 01 > 1
Node 427: 0 > 01
Hyphessobrycon micropterus: 0 > 01
Node 412: 1 > 0
Galeocharax humeralis: 0 > 1
Knodus moenkhausii: 1 > 01
Bario steindachneri: 0 > 1
Hasemania hanseni: 1 > 01
Node 343: 0 > 1
Hyphessobrycon werneri: 01 > 1
Hyphessobrycon rosaceus: 01 > 0
Hyphessobrycon megalopterus: 01 > 1
Node 433: 01 > 0
Node 436: 01 > 1
Hyphessobrycon hasemani: 0 > 01
Hyphessobrycon haraldschultzi: 0 > 1
Node 375: 1 > 0
Bryconella pallidifrons: 0 > 01
New Genus 0 > 1
Char. 22 (6 steps)
Root: 01
Distichodus maculatus: 01 > 0
Node 248: 01 > 1
Node 247: 01 > 0
Node 242: 01 > 1
Node 261: 01 > 1
Node 260: 01 > 0
Engraulisoma taeniatum: 01 > 0
Node 250: 01 > 1
Salminus brasiliensis: 0 > 01
Brycinus carolinae: 0 > 1
Brycon pesu: 0 > 1
Bryconaethiops macrops: 0 > 01
Char. 23 (14 steps)
Root: 1
Node 251: 1 > 01
Engraulisoma taeniatum: 01 > 0
Metynnis maculatus: 1 > 01
Node 268: 1 > 01
Piabucus melanostomus: 01 > 0
Bryconops alburnoides: 1 > 0
Node 288: 1 > 0
Node 360: 0 > 1
Astyanax correntinus: 0 > 1
Oligosarcus cf. *jenynsii*: 0 > 01
Oligosarcus bolivianus: 0 > 01
Node 300: 0 > 1
Carlana eigenmanni: 1 > 0
Charax stenopterus: 1 > 01
Node 344: 0 > 01
Aphyocharax nattereri: 0 > 01
Axelrodia lindeae: 01 > 1
Acrobrycon tarijae: 0 > 01
Node 362: 0 > 1
Hemigrammus unilineatus: 0 > 01
Hemigrammus ulreyi: 0 > 01
Hemigrammus erythrozonus: 0 > 1
Thayeria boehlkei: 0 > 01
Node 334: 0 > 01
Bryconamericus thomasi: 0 > 01
Node 392: 0 > 1
Pristella maxillaris: 0 > 01
Bryconamericus exodon: 0 > 01
Bryconamericus cf. *rubropictus*: 01 > 1
Hyphessobrycon eques: 0 > 01
Paracheirodon axelrodi: 0 > 1
Char. 24 (2 steps)
Root: 1
Node 261: 1 > 0
Node 254: 1 > 0
Char. 25 (3 steps)
Root: 0
Node 253: 0 > 1
Node 247: 0 > 01
Hemiodus cf. *thayeria*: 01 > 1
Leporinus striatus: 01 > 1
Node 245: 01 > 0
Char. 26 (2 steps)
Root: 0
Roeboexodon geryi: 0 > 1
Node 338: 0 > 1
Char. 27 (5 steps)
Root: 0
Chalceus macrolepidotus: 0 > 1
Node 315: 0 > 1
Node 310: 0 > 1
Hemigrammus tridens: 0 > 01
Cheirodon interruptus: 1 > 01
Hyphessobrycon copelandi: 0 > 01
Node 410: 0 > 01
Node 446: 01 > 1
Node 408: 01 > 1
Bryconella pallidifrons: 01 > 0
Char. 28 (1 step)
Root: 0
Node 310: 0 > 1
Char. 29 (2 steps)
Root: 1
Node 253: 1 > 01
Node 252: 01 > 0
Pyrrhulina australis: 01 > 1
Hoplias cf. *malabaricus*: 01 > 0
Char. 30 (2 steps)
Root: 0
Node 260: 0 > 1
Node 264: 1 > 0
Lonchogenys ilisha: 1 > 01
Char. 31 (10 steps)
Root: 0
Node 324: 0 > 1
Inpaichthys kerri: 0 > 1
Prodontocharax melanotus: 0 > 1
Aphyocharacidium bolivianum: 0 > 1
Node 342: 1 > 0
Node 318: 1 > 01
Pseudocorynopoma doriae: 01 > 0
Node 339: 1 > 0
Node 377: 0 > 01
Nematobrycon palmeri: 01 > 1
Coptobrycon bilineatus: 01 > 0
Node 375: 01 > 1
Creagrutus anary: 0 > 1
Char. 32 (1 step)
Root: 0
Node 276: 0 > 01
Node 275: 01 > 1
Char. 33 (5 steps)
Root: 0
Hyphessobrycon elachys: 0 > 1
Cheirodon troemneri: 0 > 1
Hyphessobrycon megalopterus: 0 > 1
Coptobrycon bilineatus: 0 > 1
Node 447: 0 > 1
Hyphessobrycon axelrodi: 0 > 01
Char. 34 (5 steps)
Root: 0
Node 261: 0 > 1
Leporinus striatus: 0 > 1
Node 254: 0 > 1
Roeboexodon geryi: 0 > 1
Galeocharax humeralis: 0 > 1
Char. 35 (5 steps)
Root: 1
Leporinus striatus: 1 > 0
Rhaphiodon vulpinus: 1 > 0
Node 276: 1 > 0
Pristella maxillaris: 1 > 0
Mimagoniates rheocharis: 1 > 0
Bryconamericus cf. *rubropictus*: 1 > 01
Char. 36 (3 steps)
Root: 3
Node 244: 3 > 0
Node 242: 0 > 1
Node 263: 0 > 2
Char. 37 (8 steps)
Root: 1
Node 248: 1 > 0
Hemiodus cf. *thayeria*: 1 > 0
Node 250: 1 > 0
Node 258: 1 > 0
Chalceus macrolepidotus: 1 > 01
Salminus brasiliensis: 0 > 01
Rhaphiodon vulpinus: 0 > 1
Markiana nigripinnis: 0 > 01
Hollandichthys multifasciatus: 0 > 01
Node 275: 0 > 1

Node 296: 0 > 01
Roeboides descalvadensis: 01 > 0
Roeboides microlepis: 01 > 1
Node 303: 01 > 1
Char. 38 (20 steps)
Root: 1
Node 248: 1 > 0
Hemiodus cf. *thayeria*: 1 > 0
Hoplias cf. *malabaricus*: 1 > 0
Node 259: 1 > 0
Salminus brasiliensis: 0 > 01
Node 288: 0 > 1
Node 420: 1 > 0
Node 452: 1 > 0
Node 390: 1 > 01
Bryconexodon juruenae: 1 > 0
Hyphessobrycon luetkenii: 0 > 01
Node 421: 1 > 0
Hemigrammus tridens: 1 > 0
Node 405: 01 > 0
Node 362: 1 > 0
Hemigrammus parana: 1 > 0
Node 393: 1 > 0
Hemigrammus bleheri: 01 > 0
Hemigrammus erythrozonus: 01 > 1
Acestrocephalus sardina: 1 > 01
Galeocharax humeralis: 1 > 0
Hasemania hanseni: 1 > 0
Hyphessobrycon amandae: 1 > 0
Node 408: 1 > 01
Brittanichthys axelrodi: 01 > 0
New Genus: 01 > 0
Hyphessobrycon axelrodi: 01 > 1
Char. 39 (4 steps)
Root: 1
Pyrrhulina australis: 1 > 0
Thoracocharax stellatus: 1 > 0
Node 290: 1 > 0
Node 406: 1 > 0
Hoplocharax goethei: 0 > 01
Cheirodon interruptus: 0 > 01
Char. 40 (18 steps)
Root: 0
Hoplocharax goethei: 0 > 01
Heterocharax macrolepis: 0 > 01
Astyanax latens: 0 > 01
Node 307: 0 > 1
Gymnocorymbus ternetzi: 0 > 01
Hyphessobrycon anisitsi: 0 > 01
Astyanax cf. *eigenmanniorum* 2: 0 > 01
Node 430: 0 > 01
Astyanax puka: 0 > 01
Hyphessobrycon igneus: 01 > 1
Psellogrammus kennedyi: 0 > 01
Astyanax troya: 0 > 01
Node 369: 0 > 1
Hemigrammus ocellifer: 0 > 01
Moenkhausia sanctaefilomenae: 1 > 01
Moenkhausia forestii: 1 > 01
Nematocharax venustus: 0 > 01
Hyphessobrycon cachimbensis: 1 > 0
Hyphessobrycon savagei: 1 > 01
Prodontocharax melanotus: 0 > 01
Node 456: 1 > 0
Node 387: 1 > 01
Bryconexodon juruenae: 0 > 1
Node 429: 1 > 0
Hyphessobrycon loweae: 1 > 0
Hasemania nana: 01 > 0
Cheirodon jaguaribensis: 1 > 0
Odontostilbe paraguayensis: 0 > 01
Bryconamericus alpha: 0 > 01
Node 392: 1 > 01
Node 415: 1 > 01
Hyphessobrycon socolofi: 1 > 01
Hyphessobrycon pulchripinnis: 1 > 01
Serrapinnus calliurus: 0 > 01
Mimagoniates rheocharis: 0 > 01
Moenkhausia cf. *intermedia*: 1 > 01
Jupiaba scologaster: 01 > 0
Cheirodon aff. *troemneri*: 01 > 0
Node 435: 0 > 1
Node 434: 0 > 1
Hyphessobrycon ecuadoriensis: 1 > 0
Node 376: 1 > 01
Hyphessobrycon pyrrhonotus: 1 > 01
Node 375: 01 > 0
Node 408: 1 > 01
Brittanichthys axelrodi: 01 > 0
New Genus: 01 > 1
Hyphessobrycon axelrodi: 01 > 0
Char. 41 (6 steps)
Root: 01
Node 241: 01 > 0
Puntius tetrazona: 01 > 1
Node 242: 0 > 1
Node 261: 0 > 1
Node 250: 0 > 1
Brycinus carolinae: 0 > 1
Brycon pesu: 0 > 1
Char. 42 (1 step)
Root: 0
Node 274: 0 > 1
Char. 43 (1 step)
Root: 0
Node 344: 0 > 1
Microschemobrycon casiquiare: 0 > 01
Hyphessobrycon erythrostigma: 0 > 01
New Genus: 0 > 01
Char. 44 (2 steps)
Root: 0
Node 323: 0 > 1
Mimagoniates rheocharis: 1 > 0
Char. 45 (7 steps)
Root: 0
Serrasalmus maculatus: 0 > 1
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Node 305: 0 > 1
Node 298: 0 > 1
Node 275: 0 > 1
Rhoadsia altipinna: 0 > 1
Node 295: 1 > 0
Phenagoniates macrolepis: 1 > 01
Pristella maxillaris: 0 > 01
Mimagoniates rheocharis: 0 > 01
Nematobrycon palmeri: 0 > 01
Char. 46 (3 steps)
Root: 0
Node 290: 0 > 1
Iguanodectes geisleri: 0 > 1
Pseudocorynopoma doriae: 1 > 0
Char. 47 (19 steps)
Root: 0
Node 248: 0 > 1
Hemiodus cf. *thayeria*: 0 > 1
Node 258: 0 > 1
Salminus brasiliensis: 1 > 0
Brycon orbignyanus: 1 > 0
Astyanax latens: 1 > 01
Bryconamericus scleroparius: 1 > 0
Astyanax mexicanus: 1 > 01
Hyphessobrycon togoi: 1 > 01
Astyanax correntinus: 1 > 01
Astyanax goyanensis: 1 > 0
Hyphessobrycon bifasciatus: 1 > 01
Node 349: 1 > 0
Node 431: 1 > 01
Hollandichthys multifasciatus: 1 > 0
Hyphessobrycon langeanii: 01 > 0
Node 297: 1 > 01
Node 292: 1 > 0
Aphyocharax nattereri: 1 > 0
Attonitus ephimeros: 1 > 0
Node 295: 01 > 0
Roeboides descalvadensis: 01 > 1
Roeboides microlepis: 01 > 0
Hyphessobrycon micropterus: 1 > 01
Pseudocorynopoma doriae: 1 > 0
Diapoma terofali: 1 > 01
Node 401: 1 > 0
Node 376: 1 > 0
Bryconella pallidifrons: 1 > 01
Paracheirodon simulans: 1 > 0
New Genus: 1 > 01
Char. 48 (14 steps)
Root: 1
Node 272: 1 > 01
Node 406: 01 > 0
Agoniates anchovia: 1 > 0
Node 288: 1 > 01
Node 287: 01 > 0
Tetragonopterus argenteus: 1 > 01
Bramocharax bransfordii: 01 > 1
Oligosarcus sp. n.: 01 > 0
Oligosarcus argenteus: 01 > 1
Node 402: 01 > 0
Node 302: 0 > 1
Node 420: 0 > 1
Hasemania kalunga: 0 > 01
Moenkhausia sanctaefilomenae: 1 > 01
Moenkhausia forestii: 1 > 01
Node 298: 1 > 0
Aphyodite grammica: 0 > 01
Node 397: 0 > 1
Astyanax ribeirae: 1 > 01
Hyphessobrycon luetkenii: 1 > 01
Hemigrammus tridens: 1 > 01
Hyphessobrycon elachys: 1 > 01
Hyphessobrycon moniliger: 1 > 01
Hemigrammus unilineatus: 1 > 01
Node 413: 1 > 0
Microschemobrycon casiquiare: 1 > 01
Hyphessobrycon takasei: 1 > 01
Hyphessobrycon pulchripinnis: 1 > 01
Hyphessobrycon micropterus: 1 > 01
Bario steindachneri: 1 > 01
Cheirodon aff. *troemneri*: 1 > 0
Hyphessobrycon amandae: 0 > 01
Hyphessobrycon hasemani: 1 > 0
Paracheirodon axelrodi: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 49 (2 steps)
Root: 0
Hollandichthys multifasciatus: 0 > 01
Inpaichthys kerri: 0 > 1
Node 294: 0 > 01
Xenagoniates bondi: 01 > 1
Char. 50 (2 steps)
Root: 0
Node 254: 0 > 1
Node 275: 0 > 1
Char. 51 (3 steps)
Root: 0
Metynnis maculatus: 0 > 1
Node 308: 0 > 1
Hyphessobrycon socolofi: 0 > 01
Cynopotamus argenteus: 0 > 1
Char. 52 (15 steps)
Root: 1
Node 267: 1 > 01
Node 266: 01 > 0
Brycon orbignyanus: 1 > 01
Node 309: 1 > 0
Astyanax correntinus: 1 > 01

Psellogrammus kennedyi: 1 > 0
Markiana nigripinnis: 1 > 01
Astyanax cf. *abramis*: 1 > 01
Astyanax abramis: 1 > 01
Pseudochalceus kyburzi: 1 > 01
Hyphessobrycon langeanii: 1 > 0
Rhoadsia altipinna: 1 > 01
Node 297: 1 > 01
Node 381: 1 > 0
Charax stenopterus: 01 > 0
Hyphessobrycon herbertaxelrodi: 1 > 01
Node 306: 01 > 0
Node 295: 01 > 1
Hemigrammus parana: 1 > 0
Hyphessobrycon compressus: 1 > 0
Parapristella georgiae: 1 > 0
Hemigrammus bleheri: 1 > 01
Hyphessobrycon takasei: 1 > 0
Node 377: 0 > 1
Hyphessobrycon sweglesi: 1 > 0
Paracheirodon axelrodi: 0 > 1
Paracheirodon innesi: 0 > 01
Node 425: 0 > 1
Char. 53 (27 steps)
Root: 1
Node 267: 1 > 0
Prochilodus lineatus: 1 > 0
Node 290: 1 > 0
Piabucus melanostomus: 1 > 0
Brycon meeki: 1 > 0
Node 262: 1 > 0
Bryconops alburnoides: 1 > 01
Brycon orbignyanus: 1 > 0
Lonchogenys ilisha: 0 > 1
Bramocharax bransfordii: 0 > 1
Astyanax goyanensis: 0 > 01
Astyanax courensis: 0 > 01
Hyphessobrycon bifasciatus: 0 > 01
Astyanax janeiroensis: 0 > 1
Node 279: 0 > 1
Hyphessobrycon griemi: 0 > 01
Node 399: 0 > 1
Hyphessobrycon boulengeri: 1 > 01
Hemigrammus tocantinsi: 1 > 01
Hemigrammus ocellifer: 1 > 01
Node 452: 0 > 01
Node 383: 0 > 1
Node 451: 01 > 1
Hyphessobrycon tortuguerae: 0 > 01
Roeboexodon geryi: 0 > 01
Node 458: 01 > 0
Node 456: 01 > 1
Node 440: 0 > 1
Charax stenopterus: 0 > 01
Node 292: 1 > 0
Bryconamericus iheringii: 1 > 01
Node 414: 0 > 01
Node 417: 0 > 01
Hyphessobrycon loweae: 1 > 01
Hyphessobrycon heliacus: 1 > 01
Parecbasis cyclolepis: 1 > 0
Hemigrammus parana: 01 > 1
Hyphessobrycon compressus: 0 > 1
Hyphessobrycon rutiliflavidus: 1 > 01
Odontostilbe paraguayensis: 1 > 0
Deuterodon langei: 1 > 0
Node 361: 0 > 01
Hyphessobrycon takasei: 01 > 1
Pristella maxillaris: 0 > 01
Hyphessobrycon micropterus: 0 > 01
Cheirodon interruptus: 1 > 01
Bario steindachneri: 01 > 1
Hyphessobrycon copelandi: 0 > 01
Hyphessobrycon werneri: 0 > 01
Hyphessobrycon rosaceus: 0 > 01
Hyphessobrycon bentosi: 0 > 01
Nematobrycon palmeri: 1 > 0
Hyphessobrycon hasemani: 0 > 01
Hyphessobrycon minor: 0 > 01
Hyphessobrycon haraldschultzi: 0 > 01
Hyphessobrycon sweglesi: 0 > 1
Hyphessobrycon axelrodi: 1 > 0
Char. 54 (5 steps)
Root: 0
Node 254: 0 > 01
Acestrorhynchus pantaneiro: 01 > 1
Markiana nigripinnis: 0 > 1
Node 296: 0 > 01
Bryconexodon juruenae: 0 > 1
Bryconamericus iheringii: 0 > 01
Node 306: 01 > 1
Node 303: 01 > 1
Acestrocephalus sardina: 01 > 0
Char. 55 (3 steps)
Root: 01
Node 241: 01 > 0
Puntius tetrazona: 01 > 1
Hoplias cf. *malabaricus*: 0 > 1
Inpaichthys kerri: 0 > 1
Char. 56 (4 steps)
Root: 0
Node 251: 0 > 1
Node 255: 0 > 01
Node 406: 0 > 1
Agoniates anchovia: 01 > 1
Rhaphiodon vulpinus: 01 > 1
Acestrorhynchus pantaneiro: 01 > 0
Char. 57 (3 steps)
Root: 1
Node 252: 1 > 0
Node 264: 0 > 1
Cyanocharax alegretensis: 0 > 01
Galeocharax humeralis: 0 > 1
Char. 58 (4 steps)
Root: 0
Node 293: 0 > 1
Node 415: 0 > 1
Hyphessobrycon micropterus: 0 > 01
Hyphessobrycon rosaceus: 0 > 01
Hyphessobrycon haraldschultzi: 0 > 01
Hyphessobrycon erythrostigma: 0 > 01
Gymnocharacinus bergii: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 59 (5 steps)
Root: 0
Engraulisoma taeniatum: 0 > 1
Node 255: 0 > 01
Agoniates anchovia: 01 > 1
Rhaphiodon vulpinus: 01 > 0
Acestrorhynchus pantaneiro: 01 > 1
Heterocharax macrolepis: 0 > 1
Node 372: 0 > 1
Char. 60 (2 steps)
Root: 0
Node 374: 0 > 1
Node 406: 0 > 1
Char. 61 (7 steps)
Root: 0
Node 253: 0 > 01
Node 252: 01 > 1
Pyrrhulina australis: 01 > 0
Hoplias cf. *malabaricus*: 01 > 1
Node 265: 1 > 0
Node 290: 1 > 0
Node 406: 1 > 0
Hollandichthys multifasciatus: 0 > 1
Mimagoniates rheocharis: 0 > 1
Char. 62 (26 steps)
Root: 0
Pyrrhulina australis: 0 > 1
Node 256: 0 > 2
Bryconops alburnoides: 0 > 1
Bryconops melanurus: 0 > 2
Node 404: 0 > 2
Markiana nigripinnis: 0 > 1
Node 278: 0 > 1
Astyanax altiparanae: 0 > 01
Node 441: 0 > 02
Moenkhausia pittieri: 0 > 2
Moenkhausia hemigrammoides: 0 > 02
Node 299: 0 > 2
Hollandichthys multifasciatus: 0 > 2
Hyphessobrycon boulengeri: 0 > 2
Hyphessobrycon panamensis: 02 > 2
Ectrepopterus uruguayensis: 0 > 2
Hyphessobrycon tortuguerae: 02 > 2
Hyphessobrycon savagei: 02 > 0
Node 440: 0 > 02
Bryconexodon juruenae: 2 > 1
Astyanax ribeirae: 0 > 01
Node 443: 02 > 2
Hyphessobrycon heliacus: 0 > 02
Acrobrycon tarijae: 1 > 0
Astyanax jenynsii: 0 > 1
Moenkhausia sp. n.: 0 > 02
Hyphessobrycon moniliger: 0 > 02
Node 416: 0 > 01
Microschemobrycon melanotus: 1 > 0
Jupiaba polylepis: 0 > 2
Hyphessobrycon micropterus: 0 > 01
Hyphessobrycon negodagua: 0 > 2
Knodus meridae: 1 > 02
Moenkhausia xinguensis: 0 > 02
Cheirodon troemneri: 01 > 1
Hyphessobrycon copelandi: 0 > 01
Hyphessobrycon hasemani: 0 > 1
Paracheirodon axelrodi: 0 > 01
Paracheirodon innesi: 0 > 1
Hyphessobrycon axelrodi: 0 > 1
Char. 63 (7 steps)
Root: 0
Hyphessobrycon griemi: 0 > 1
Node 419: 0 > 1
Moenkhausia hemigrammoides: 0 > 01
Hasemania kalunga: 1 > 01
Hyphessobrycon panamensis: 0 > 01
Hyphessobrycon heliacus: 0 > 01
Hyphessobrycon moniliger: 0 > 01
Node 428: 0 > 01
Hyphessobrycon rutiliflavidus: 0 > 01
Microschemobrycon melanotus: 0 > 01
Hyphessobrycon socolofi: 0 > 1
Node 432: 01 > 0
Node 427: 01 > 1
Hyphessobrycon micropterus: 01 > 1
Hyphessobrycon negodagua: 0 > 01
Hasemania hanseni: 0 > 01
Hyphessobrycon eques: 0 > 01
Hyphessobrycon bentosi: 1 > 01
Node 376: 0 > 01
Hyphessobrycon minor: 0 > 01
Hyphessobrycon haraldschultzi: 0 > 01
Hyphessobrycon sweglesi: 1 > 01
Hyphessobrycon pyrrhonotus: 1 > 01
Hyphessobrycon erythrostigma: 1 > 01
Coptobrycon bilineatus: 01 > 1
Bryconella pallidifrons: 0 > 1
Char. 64 (35 steps)
Root: 01
Node 241: 01 > 0
Puntius tetrazona: 01 > 1
Node 248: 0 > 1
Node 246: 0 > 01
Node 260: 0 > 01
Leporinus striatus: 01 > 1

Node 267: 01 > 1
Prochilodus lineatus: 01 > 1
Cyphocharax spilotus: 01 > 0
Thoracocharax stellatus: 0 > 1
Node 257: 01 > 1
Node 264: 01 > 0
Chalceus macrolepidotus: 01 > 1
Node 268: 01 > 0
Node 289: 01 > 1
Node 305: 01 > 0
Bryconops alburnoides: 01 > 0
Node 373: 01 > 1
Brycon pesu: 1 > 01
Node 406: 1 > 0
Agoniates anchovia: 1 > 0
Bryconamericus scleroparius: 1 > 0
Stichonodon insignis: 1 > 0
Markiana nigripinnis: 1 > 0
Node 278: 1 > 0
Node 399: 1 > 0
Pseudochalceus kyburzi: 1 > 0
Node 310: 1 > 0
Roeboexodon geryi: 1 > 0
Aphyodite grammica: 0 > 1
Charax stenopterus: 1 > 0
Cyanocharax alegretensis: 0 > 1
Hasemania nana: 1 > 0
Axelrodia lindeae: 0 > 1
Microschemobrycon melanotus: 0 > 1
Node 445: 0 > 1
Jupiaba polylepis: 1 > 0
Pristella maxillaris: 1 > 0
Node 401: 0 > 1
Bryconamericus rubropictus: 0 > 1
Moenkhausia xinguensis: 1 > 0
Nematobrycon palmeri: 1 > 0
Creagrutus cf. *taphorni*: 0 > 1
Paracheirodon simulans: 1 > 0
Brittanichthys axelrodi: 1 > 01
Char. 65 (4 steps)
Root: 0
Hemiodus cf. *thayeria*: 0 > 1
Pyrrhulina australis: 0 > 1
Cyphocharax spilotus: 0 > 01
Micralestes stormsi: 0 > 1
Piabucus melanostomus: 0 > 1
Char. 66 (16 steps)
Root: 0
Node 251: 0 > 1
Node 266: 0 > 1
Hoplocharax goethei: 0 > 1
Node 391: 0 > 1
Hasemania kalunga: 0 > 01
Node 276: 0 > 1
Node 310: 0 > 1
Aphyodite grammica: 0 > 1
Charax stenopterus: 0 > 01
Node 292: 1 > 0
Hasemania nana: 0 > 1
Node 306: 0 > 1
Hyphessobrycon compressus: 0 > 01
Hemigrammus erythrozonus: 0 > 1
Hyphessobrycon pulchripinnis: 0 > 01
Mimagoniates rheocharis: 0 > 01
Cheirodon troemneri: 0 > 1
Node 411: 0 > 1
Node 377: 0 > 01
Nantis indefessus: 0 > 01
Hyphessobrycon eques: 0 > 01
Hyphessobrycon werneri: 0 > 01
Hyphessobrycon megalopterus: 0 > 1
Nematobrycon palmeri: 01 > 1
Coptobrycon bilineatus: 01 > 1
Node 375: 01 > 0
Char. 67 (32 steps)
Root: 01
Distichodus maculatus: 01 > 1
Hemiodus cf. *thayeria*: 01 > 0
Node 246: 01 > 1
Parodon nasus: 01 > 0
Apareiodon affinis: 01 > 1
Node 260: 01 > 0
Pyrrhulina australis: 01 > 1
Hoplias cf. *malabaricus*: 01 > 0
Node 269: 0 > 1
Bryconops alburnoides: 1 > 0
Node 406: 0 > 1
Bryconops melanurus: 1 > 01
Node 336: 1 > 0
Astyanax paris: 1 > 0
Astyanax mexicanus: 1 > 0
Node 356: 1 > 01
Node 280: 1 > 0
Hyphessobrycon igneus: 1 > 01
Astyanax janeiroensis: 01 > 0
Node 349: 1 > 0
Astyanax troya: 01 > 0
Astyanax chico: 01 > 1
Node 385: 0 > 1
Node 431: 0 > 01
Astyanax jacuhiensis: 0 > 1
Astyanax asuncionensis: 0 > 1
Astyanax cf. *asuncionensis*: 0 > 1
Probolodus heterostomus: 0 > 1
Hyphessobrycon boulengeri: 01 > 1
Hemigrammus tocantinsi: 0 > 01
Node 315: 0 > 01
Moenkhausia sanctaefilomenae: 0 > 01
Moenkhausia forestii: 0 > 01
Node 298: 0 > 01
Node 314: 01 > 1
Phenacogaster tegatus: 01 > 1
Charax stenopterus: 01 > 1
Node 397: 01 > 0
Node 344: 01 > 1
Node 394: 0 > 1
Hemigrammus tridens: 1 > 0
Node 295: 01 > 0
Node 342: 0 > 01
Astyanax intermedius: 0 > 1
Node 362: 0 > 1
Parapristella georgiae: 1 > 0
Node 445: 01 > 1
Hyphessobrycon socolofi: 0 > 1
Node 378: 1 > 01
Bario steindachneri: 1 > 01
Hasemania hanseni: 01 > 0
Char. 68 (3 steps)
Root: 0
Node 254: 0 > 1
Node 403: 0 > 01
Node 402: 01 > 1
Node 296: 0 > 01
Node 295: 01 > 1
Char. 69 (16 steps)
Root: 0
Node 268: 0 > 1
Bryconops alburnoides: 0 > 01
Node 309: 0 > 1
Hoplocharax goethei: 0 > 1
Astyanax latens: 0 > 1
Stethaprion erythrops: 1 > 0
Node 283: 0 > 1
Psellogrammus kennedyi: 0 > 1
Node 418: 1 > 01
Moenkhausia pittieri: 1 > 01
Cheirodon stenodon: 01 > 0
Node 372: 1 > 0
Hyphessobrycon tortuguerae: 1 > 01
Node 313: 1 > 0
Node 274: 1 > 01
Node 296: 1 > 0
Node 273: 01 > 0
Parecbasis cyclolepis: 1 > 0
Hyphessobrycon pulchripinnis: 1 > 0
Cheirodon interruptus: 0 > 1
Hasemania hanseni: 1 > 0
Hyphessobrycon hasemani: 1 > 01
Char. 70 (5 steps)
Root: 0
Node 261: 0 > 1
Node 250: 0 > 1
Micralestes stormsi: 0 > 1
Node 290: 0 > 1
Lonchogenys ilisha: 1 > 0
Char. 71 (5 steps)
Root: 0
Node 242: 0 > 1
Prochilodus lineatus: 0 > 1
Node 257: 0 > 1
Node 264: 0 > 01
Node 263: 01 > 1
Agoniates anchovia: 1 > 0
Char. 72 (8 steps)
Root: 0
Chalceus macrolepidotus: 0 > 1
Node 374: 0 > 1
Iguanodectes geisleri: 0 > 1
Brycon falcatus: 0 > 1
Astyanax mexicanus: 0 > 01
Node 407: 0 > 1
Hyphessobrycon togoi: 0 > 01
Astyanax altiparanae: 0 > 1
Hyphessobrycon boulengeri: 0 > 1
Hemigrammus parana: 0 > 01
Hemigrammus bleheri: 0 > 01
Hyphessobrycon takasei: 0 > 01
Node 435: 0 > 01
Node 438: 01 > 1
Hyphessobrycon rosaceus: 0 > 01
Hyphessobrycon minor: 1 > 01
Char. 73 (14 steps)
Root: 0
Brycon orbignyanus: 0 > 01
Node 437: 0 > 1
Hyphessobrycon igneus: 0 > 1
Hyphessobrycon boulengeri: 0 > 1
Ectrepopterus uruguayensis: 0 > 1
Node 382: 0 > 1
Hyphessobrycon tortuguerae: 0 > 1
Node 458: 0 > 1
Node 453: 0 > 1
Hyphessobrycon elachys: 0 > 1
Hyphessobrycon compressus: 0 > 1
Node 398: 0 > 01
Pristella maxillaris: 0 > 1
Moenkhausia dichroura: 01 > 1
Hyphessobrycon megalopterus: 0 > 1
Paracheirodon innesi: 1 > 0
Char. 74 (14 steps)
Root: 0
Node 247: 0 > 1
Cyphocharax spilotus: 1 > 01
Piaractus mesopotamicus: 0 > 1
Node 257: 0 > 1
Chalceus macrolepidotus: 0 > 1
Node 374: 0 > 1
Node 406: 1 > 0
Node 254: 1 > 01
Rhaphiodon vulpinus: 01 > 0
Bryconamericus scleroparius: 0 > 1
Node 356: 0 > 1
Node 349: 0 > 1
Astyanax chico: 1 > 01
Astyanax altiparanae: 1 > 0

Probolodus heterostomus: 0 > 01
Node 452: 0 > 1
Node 371: 0 > 1
Astyanax ribeirae: 1 > 01
Node 306: 0 > 1
Acestrocephalus sardina: 0 > 01
Deuterodon iguape: 1 > 01
Hyphessobrycon pulchripinnis: 0 > 01
Moenkhausia xinguensis: 0 > 01
Char. 75 (2 steps)
Root: 0
Hemiodus cf. *thayeria*: 0 > 1
Chalceus macrolepidotus: 0 > 1
Char. 76 (17 steps)
Root: 0
Node 247: 0 > 1
Node 260: 0 > 01
Cyphocharax spilotus: 1 > 0
Node 266: 01 > 0
Piaractus mesopotamicus: 01 > 1
Chalceus macrolepidotus: 01 > 1
Node 268: 01 > 0
Node 271: 01 > 1
Micralestes stormsi: 01 > 0
Node 263: 01 > 1
Salminus brasiliensis: 01 > 1
Bryconops alburnoides: 01 > 0
Node 373: 01 > 1
Agoniates anchovia: 01 > 0
Node 288: 01 > 0
Node 304: 01 > 1
Rhaphiodon vulpinus: 01 > 1
Acestrorhynchus pantaneiro: 01 > 0
Node 308: 01 > 0
Tetragonopterus argenteus: 01 > 1
Oligosarcus cf. *jenynsii*: 0 > 1
Markiana nigripinnis: 0 > 1
Node 372: 0 > 01
Node 371: 01 > 1
Deuterodon supparis: 0 > 1
Node 296: 0 > 1
Odontostilbe microcephala: 0 > 1
Cheirodon aff. *troemneri*: 0 > 01
Char. 77 (9 steps)
Root: 0
Node 261: 0 > 01
Pyrrhulina australis: 01 > 1
Micralestes stormsi: 0 > 1
Node 255: 0 > 01
Brycon pesu: 0 > 01
Agoniates anchovia: 01 > 1
Rhaphiodon vulpinus: 01 > 0
Acestrorhynchus pantaneiro: 01 > 1
Node 275: 0 > 1
Bryconamericus mennii: 0 > 01
Node 326: 0 > 1
Phenagoniates macrolepis: 1 > 0
Bryconamericus alpha: 0 > 01
Bryconamericus cf. *iheringii*: 1 > 01
Bryconamericus cf. *rubropictus*: 1 > 01
Nantis indefessus: 1 > 01
Node 376: 0 > 01
Aulixidens eugeniae: 1 > 0
Piabina argentea: 1 > 01
Gymnocharacinus bergii: 01 > 1
Char. 78 (1 step)
Root: 0
Node 275: 0 > 1
Char. 79 (11 steps)
Root: 0
Hyphessobrycon griemi: 0 > 1
Aphyocharax nattereri: 0 > 1
Hyphessobrycon elachys: 0 > 1
Thayeria boehlkei: 0 > 1
Bryconamericus cf. *iheringii*: 0 > 01
Bryconamericus rubropictus: 0 > 1
Node 411: 0 > 1
Nantis cf. *indefessus*: 0 > 1
Hyphessobrycon megalopterus: 0 > 1
Node 376: 0 > 01
Coptobrycon bilineatus: 01 > 1
Paracheirodon axelrodi: 1 > 0
Gymnocharacinus bergii: 01 > 0
Grundulus cochae: 01 > 1
Char. 80 (3 steps)
Root: 0
Rhaphiodon vulpinus: 0 > 1
Node 403: 0 > 1
Node 297: 0 > 1
Char. 81 (9 steps)
Root: 01
Distichodus maculatus: 01 > 0
Node 243: 01 > 1
Node 253: 01 > 1
Node 248: 01 > 0
Node 250: 1 > 0
Chalceus macrolepidotus: 1 > 0
Metynnis maculatus: 1 > 0
Node 255: 1 > 0
Node 289: 1 > 0
Brycon pesu: 1 > 0
Markiana nigripinnis: 0 > 1
Char. 82 (9 steps)
Root: 01
Puntius tetrazona: 01 > 1
Distichodus maculatus: 01 > 0
Node 249: 01 > 0
Node 243: 01 > 1
Cyphocharax spilotus: 1 > 0
Node 265: 0 > 1
Stichonodon insignis: 0 > 1
Prodontocharax melanotus: 0 > 01
Parecbasis cyclolepis: 0 > 1
Node 316: 0 > 1
Aphyocharax anisitsi: 0 > 01
Node 361: 0 > 01
Pristella maxillaris: 0 > 1
Bario steindachneri: 01 > 1
Hyphessobrycon eques: 0 > 01
Char. 83 (3 steps)
Root: 0
Engraulisoma taeniatum: 0 > 01
Node 269: 0 > 01
Node 291: 01 > 1
Micralestes stormsi: 0 > 01
Piabucus melanostomus: 01 > 1
Iguanodectes geisleri: 01 > 0
Acestrorhynchus pantaneiro: 0 > 1
Char. 84 (4 steps)
Root: 0
Node 324: 0 > 1
Node 396: 0 > 1
Node 338: 1 > 0
Brittanichthys axelrodi: 0 > 1
Char. 85 (2 steps)
Root: 0
Node 406: 0 > 1
Heterocharax macrolepis: 0 > 1
Markiana nigripinnis: 0 > 01
Galeocharax humeralis: 0 > 01
Char. 86 (3 steps)
Root: 0
Node 305: 0 > 01
Agoniates anchovia: 0 > 1
Node 304: 01 > 1
Node 295: 0 > 01
Roeboides descalvadensis: 0 > 01
Node 303: 01 > 1
Char. 87 (1 step)
Root: 0
Node 248: 0 > 1
Char. 88 (5 steps)
Root: 0
Characidium rachovii: 0 > 1
Node 269: 0 > 01
Serrasalmus maculatus: 0 > 1
Node 290: 01 > 1
Node 374: 01 > 0
Piabucus melanostomus: 01 > 1
Oligosarcus sp. n.: 1 > 0
Markiana nigripinnis: 1 > 01
Astyanax lineatus: 1 > 01
Rhoadsia altipinna: 1 > 01
Char. 89 (3 steps)
Root: 0
Puntius tetrazona: 0 > 01
Node 252: 0 > 1
Hemiodus cf. *thayeria*: 0 > 1
Rhaphiodon vulpinus: 1 > 0
Char. 90 (3 steps)
Root: 0
Node 251: 0 > 01
Engraulisoma taeniatum: 01 > 1
Node 265: 0 > 1
Bryconaethiops macrops: 1 > 0
Bryconops melanurus: 0 > 01
Bryconops affinis: 0 > 01
Char. 91 (25 steps)
Root: 0
Characidium rachovii: 0 > 1
Pyrrhulina australis: 0 > 1
Node 250: 0 > 01
Carnegiella strigata: 01 > 1
Hoplocharax goethei: 0 > 1
Node 284: 0 > 1
Psellogrammus kennedyi: 0 > 01
Node 369: 1 > 01
Node 385: 01 > 1
Node 324: 1 > 0
Probolodus heterostomus: 01 > 0
Moenkhausia pittieri: 01 > 0
Moenkhausia hemigrammoides: 01 > 0
Node 452: 01 > 0
Node 366: 01 > 1
Moenkhausia forestii: 01 > 1
Node 372: 1 > 0
Node 314: 1 > 0
Node 321: 0 > 01
Node 296: 1 > 0
Cyanocharax alegretensis: 01 > 1
Hyphessobrycon luetkenii: 0 > 1
Node 363: 1 > 0
Parecbasis cyclolepis: 1 > 0
Aphyocharacidium bolivianum: 1 > 0
Acrobrycon tarijae: 01 > 0
Node 393: 1 > 0
Node 317: 0 > 1
Xenagoniates bondi: 1 > 0
Node 325: 01 > 1
Pseudocorynopoma doriae: 01 > 0
Mimagoniates rheocharis: 01 > 1
Nematobrycon palmeri: 1 > 0
Gymnocharacinus bergii: 1 > 0
Char. 92 (23 steps)
Root: 0
Node 258: 0 > 1
Piaractus mesopotamicus: 0 > 1
Node 374: 1 > 0
Node 284: 1 > 0
Astyanax goyanensis: 1 > 0
Node 278: 0 > 01
Node 324: 01 > 1
Node 452: 0 > 1
Moenkhausia forestii: 0 > 1
Node 372: 0 > 01

Node 346: 01 > 0
Node 314: 01 > 1
Inpaichthys kerri: 01 > 0
Node 371: 01 > 1
Node 293: 01 > 1
Node 296: 0 > 1
Aphyocharax nattereri: 01 > 0
Node 273: 01 > 1
Bryconamericus iheringii: 1 > 0
Cyanocharax alegretensis: 1 > 0
Node 342: 1 > 0
Node 362: 0 > 01
Node 393: 0 > 1
Hemigrammus ulreyi: 0 > 01
Node 317: 1 > 0
Node 325: 1 > 0
Bryconamericus thomasi: 1 > 0
Node 398: 01 > 1
Node 401: 1 > 0
Bryconamericus rubropictus: 1 > 0
Char. 93 (6 steps)
Root: 0
Node 257: 0 > 1
Node 304: 0 > 1
Tetragonopterus argenteus: 0 > 1
Astyanax correntinus: 0 > 01
Astyanax pelegrini: 0 > 1
Node 298: 0 > 01
Node 306: 01 > 1
Node 303: 01 > 1
Acestrocephalus sardina: 01 > 0
Char. 94 (4 steps)
Root: 1
Node 264: 1 > 0
Deuterodon supparis: 1 > 0
Deuterodon stigmaturus: 1 > 0
Aulixidens eugeniae: 1 > 0
Char. 95 (1 step)
Root: 0
Node 294: 0 > 1
Char. 96 (7 steps)
Root: 0
Node 242: 0 > 1
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Node 451: 0 > 1
Rhoadsia altipinna: 0 > 1
Prodontocharax melanotus: 0 > 1
Node 294: 0 > 1
Bryconamericus agna: 0 > 01
Node 340: 0 > 1
Piabina argentea: 1 > 01
Char. 97 (3 steps)
Root: 0
Hemiodus cf. *thayeria*: 0 > 01
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Hemigrammus ocellifer: 0 > 01
Moenkhausia sanctaefilomenae: 0 > 01
Rhoadsia altipinna: 0 > 01
Carlana eigenmanni: 0 > 01
Node 313: 0 > 1
Node 450: 0 > 1
Deuterodon iguape: 1 > 01
Cheirodon troemneri: 0 > 01
Char. 98 (10 steps)
Root: 0
Node 260: 0 > 2
Node 290: 2 > 12
Node 289: 12 > 1
Node 308: 1 > 0
Hyphessobrycon togoi: 1 > 12
Node 281: 1 > 0
Hyphessobrycon igneus: 1 > 12
Hyphessobrycon bifasciatus: 1 > 01
Markiana nigripinnis: 1 > 2
Hyphessobrycon langeanii: 0 > 1
Astyanax intermedius: 0 > 1
Deuterodon rosae: 0 > 1
Deuterodon longirostris : 0 > 01
Deuterodon singularis: 0 > 1
Hyphessobrycon amandae: 0 > 12
Char. 99 (2 steps)
Root: 01
Node 249: 01 > 1
Node 243: 01 > 0
Node 268: 1 > 0
Char. 100 (14 steps)
Root: 1
Distichodus maculatus: 1 > 01
Node 253: 1 > 0
Hyphessobrycon togoi: 0 > 1
Hyphessobrycon griemi: 0 > 1
Markiana nigripinnis: 0 > 1
Moenkhausia hemigrammoides: 0 > 01
Node 315: 0 > 1
Rhoadsia altipinna: 0 > 01
Carlana eigenmanni: 0 > 01
Odontostilbe pequira: 1 > 0
Attonitus ephimeros: 0 > 1
Astyanax giton: 0 > 1
Microschemobrycon melanotus: 1 > 0
Node 415: 0 > 1
Pristella maxillaris: 0 > 01
Node 412: 0 > 1
Hyphessobrycon megalopterus: 0 > 01
Aulixidens eugeniae: 0 > 1
Hyphessobrycon haraldschultzi: 0 > 1
Paracheirodon axelrodi: 1 > 01
Hyphessobrycon axelrodi: 1 > 0
Char. 101 (1 step)
Root: 0
Node 310: 0 > 1
Char. 102 (1 step)
Root: 0
Node 274: 0 > 1
Char. 103 (6 steps)
Root: 1
Distichodus maculatus: 1 > 0
Node 265: 1 > 01
Piaractus mesopotamicus: 1 > 0
Chalceus macrolepidotus: 01 > 0
Node 271: 1 > 0
Micralestes stormsi: 01 > 1
Node 263: 01 > 0
Deuterodon singularis: 1 > 0
Char. 104 (29 steps)
Root: 1
Node 253: 1 > 01
Pyrrhulina australis: 01 > 1
Hoplias cf. *malabaricus*: 01 > 0
Node 267: 01 > 0
Engraulisoma taeniatum: 01 > 0
Node 250: 01 > 1
Node 265: 01 > 1
Node 257: 01 > 0
Node 268: 01 > 1
Node 374: 01 > 0
Node 289: 01 > 0
Node 305: 01 > 1
Stichonodon insignis: 0 > 1
Node 282: 0 > 01
Node 430: 01 > 1
Node 280: 01 > 0
Node 437: 01 > 1
Node 277: 0 > 1
Cheirodon stenodon: 0 > 1
Node 366: 0 > 1
Node 310: 0 > 1
Node 298: 0 > 01
Node 382: 0 > 1
Hyphessobrycon tortuguerae: 0 > 1
Phenacogaster tegatus: 01 > 1
Node 326: 0 > 1
Charax stenopterus: 01 > 1
Node 296: 01 > 0
Bryconamericus iheringii: 0 > 1
Node 363: 1 > 0
Node 429: 0 > 1
Hyphessobrycon herbertaxelrodi: 0 > 01
Node 389: 0 > 1
Node 294: 1 > 01
Bryconamericus agna: 0 > 1
Node 393: 1 > 0
Phenagoniates macrolepis: 01 > 0
Hyphessobrycon socolofi: 1 > 01
Hyphessobrycon pulchripinnis: 1 > 01
Pristella maxillaris: 1 > 01
Pseudocorynopoma doriae: 0 > 01
Hasemania hanseni: 1 > 0
Node 338: 1 > 0
Nematobrycon palmeri: 1 > 01
Hyphessobrycon hasemani: 1 > 01
Hyphessobrycon pyrrhonotus: 1 > 0
Brittanichthys axelrodi: 1 > 0
Char. 105 (3 steps)
Root: 0
Node 251: 0 > 1
Node 275: 0 > 1
Astyanax hastatus: 0 > 1
Char. 106 (1 step)
Root: 0
Node 264: 0 > 1
Char. 107 (8 steps)
Root: 0
Node 305: 0 > 01
Hoplocharax goethei: 01 > 1
Lonchogenys ilisha: 01 > 0
Heterocharax macrolepis: 01 > 1
Node 314: 0 > 1
Node 273: 0 > 1
Parecbasis cyclolepis: 0 > 1
Aphyocharacidium bolivianum: 0 > 1
Deuterodon stigmaturus: 0 > 1
New Genus: 0 > 1
Char. 108 (7 steps)
Root: 0
Node 260: 0 > 1
Node 291: 1 > 0
Node 256: 1 > 0
Node 351: 0 > 1
Astyanax jacuhiensis: 1 > 01
Bryconamericus mennii: 0 > 01
Node 327: 0 > 1
Xenagoniates bondi: 0 > 1
Node 338: 0 > 1
Char. 109 (18 steps)
Root: 0
Micralestes stormsi: 0 > 1
Bryconops alburnoides: 0 > 1
Node 288: 0 > 01
Bryconamericus scleroparius: 01 > 1
Node 285: 01 > 1
Astyanax paris: 01 > 0
Node 404: 01 > 0
Bramocharax bransfordii: 01 > 1
Node 282: 1 > 0
Astyanax cf. *rutilus*: 1 > 01
Node 324: 0 > 1
Hemigrammus ocellifer: 0 > 1
Nematocharax venustus: 0 > 01
Bryconamericus iheringii: 1 > 0
Attonitus ephimeros: 1 > 0
Node 443: 0 > 1
Xenagoniates bondi: 0 > 1

Pristella maxillaris: 0 > 01
Cheirodon interruptus: 0 > 01
Node 401: 1 > 0
Bario steindachneri: 0 > 1
Hyphessobrycon copelandi: 0 > 1
Hyphessobrycon eques: 0 > 01
Nematobrycon palmeri: 0 > 1
Hyphessobrycon erythrostigma: 0 > 1
Bryconella pallidifrons: 0 > 1
Char. 110 (23 steps)
Root: 01
Node 244: 01 > 1
Distichodus maculatus: 01 > 0
Characidium rachovii: 1 > 01
Node 251: 1 > 0
Hoplias cf. *malabaricus*: 1 > 0
Prochilodus lineatus: 1 > 0
Node 291: 1 > 01
Node 256: 1 > 0
Node 305: 01 > 0
Bryconops alburnoides: 01 > 1
Node 373: 01 > 0
Node 288: 01 > 1
Node 309: 01 > 0
Rhaphiodon vulpinus: 0 > 1
Astyanax latens: 1 > 01
Bramocharax bransfordii: 1 > 01
Node 284: 1 > 01
Node 283: 01 > 0
Node 360: 1 > 01
Astyanax cf. *eigenmanniorum* 2: 1 > 01
Astyanax mexicanus: 1 > 01
Oligosarcus argenteus: 1 > 0
Astyanax endy: 1 > 01
Astyanax cf. *eigenmanniorum* 1: 01 > 0
Astyanax goyanensis: 1 > 0
Astyanax puka: 1 > 01
Node 324: 0 > 1
Astyanax jacuhiensis: 1 > 0
Pseudochalceus kyburzi: 0 > 01
Hollandichthys multifasciatus: 0 > 01
Hasemania kalunga: 0 > 1
Node 452: 0 > 01
Moenkhausia forestii: 0 > 01
Nematocharax venustus: 0 > 01
Inpaichthys kerri: 0 > 01
Cyanocharax alburnus: 1 > 01
Node 451: 01 > 1
Roeboexodon geryi: 0 > 01
Prodontocharax melanotus: 0 > 01
Node 321: 1 > 01
Node 456: 01 > 1
Node 390: 0 > 1
Bryconexodon juruenae: 0 > 01
Cyanocharax alegretensis: 01 > 0
Hyphessobrycon luetkenii: 01 > 0
Thayeria obliqua: 1 > 01
Acestrocephalus sardina: 0 > 01
Node 378: 0 > 1
Mimagoniates rheocharis: 01 > 0
Diapoma speculiferum: 01 > 1
Jupiaba mucronata: 0 > 01
Cheirodon aff. *troemneri*: 0 > 1
Coptobrycon bilineatus: 1 > 01
Grundulus cochae: 1 > 01
Char. 111 (1 step)
Root: 0
Node 253: 0 > 1
Char. 112 (2 steps)
Root: 0
Piaractus mesopotamicus: 0 > 1
Node 263: 0 > 1
Char. 113 (1 step)
Root: 0
Node 242: 0 > 1
Char. 114 (2 steps)
Root: 0
Iguanodectes geisleri: 0 > 1
Node 294: 0 > 1
Char. 115 (1 step)
Root: 0
Node 268: 0 > 1
Char. 116 (1 step)
Root: 0
Node 295: 0 > 1
Char. 117 (1 step)
Root: 0
Charax stenopterus: 0 > 01
Node 306: 0 > 1
Char. 118 (8 steps)
Root: 1
Node 261: 1 > 0
Node 305: 1 > 0
Node 254: 1 > 0
Oligosarcus argenteus: 1 > 01
Nematocharax venustus: 1 > 01
Node 297: 1 > 0
Exodon paradoxus: 1 > 0
Axelrodia lindeae: 1 > 0
Node 408: 1 > 0
Grundulus cochae: 1 > 0
Char. 119 (3 steps)
Root: 0
Node 313: 0 > 1
Odontostoechus lethostigmus: 0 > 1
Gymnocharacinus bergii: 0 > 1
Char. 120 (3 steps)
Root: 0
Probolodus heterostomus: 0 > 1
Node 372: 0 > 1
Node 306: 0 > 1
Char. 121 (4 steps)
Root: 0
Node 254: 0 > 1
Node 403: 0 > 1
Node 297: 0 > 01
Charax stenopterus: 01 > 1
Node 306: 01 > 0
Node 295: 01 > 1
Char. 122 (13 steps)
Root: 01
Distichodus maculatus: 01 > 1
Node 248: 01 > 0
Node 252: 01 > 1
Hemiodus cf. *thayeria*: 01 > 0
Carnegiella strigata: 1 > 0
Piabucus melanostomus: 1 > 0
Node 277: 1 > 0
Probolodus heterostomus: 1 > 0
Ectrepopterus uruguayensis: 1 > 01
Carlana eigenmanni: 1 > 0
Charax stenopterus: 1 > 01
Paragoniates alburnus: 0 > 01
Node 415: 1 > 0
Pristella maxillaris: 1 > 01
Hyphessobrycon micropterus: 1 > 01
Hyphessobrycon ecuadoriensis: 1 > 01
Node 343: 1 > 0
Paracheirodon axelrodi: 1 > 0
Node 408: 1 > 01
Grundulus cochae: 1 > 0
Paracheirodon innesi: 1 > 01
Brittanichthys axelrodi: 01 > 0
New Genus: 01 > 1
Hyphessobrycon axelrodi: 01 > 0
Char. 123 (4 steps)
Root: 0
Chalceus macrolepidotus: 0 > 1
Node 271: 0 > 1
Bryconaethiops macrops: 0 > 1
Node 339: 0 > 01
Node 337: 01 > 1
Char. 124 (2 steps)
Root: 0
Bryconops alburnoides: 0 > 1
Bryconamericus scleroparius: 0 > 01
Hemibrycon surinamensis: 0 > 01
Hemibrycon dariensis: 0 > 01
Knodus breviceps: 0 > 01
Node 331: 0 > 1
Char. 125 (13 steps)
Root: 0
Micralestes stormsi: 0 > 1
Bryconops alburnoides: 0 > 01
Brycon orbignyanus: 0 > 1
Bryconops melanurus: 0 > 1
Node 359: 0 > 1
Hyphessobrycon togoi: 0 > 1
Astyanax cf. *rutilus*: 1 > 01
Astyanax correntinus: 0 > 1
Hyphessobrycon meridionalis: 0 > 1
Node 452: 0 > 1
Hyphessobrycon panamensis: 0 > 01
Hemibrycon dariensis: 0 > 01
Node 439: 0 > 01
Hyphessobrycon loweae: 01 > 1
Bryconamericus agna: 0 > 1
Astyanax giton: 1 > 0
Bryconamericus alpha: 0 > 01
Jupiaba scologaster: 0 > 1
Node 375: 0 > 01
Gymnocharacinus bergii: 01 > 1
Char. 126 (3 steps)
Root: 1
Node 267: 1 > 0
Node 263: 1 > 2
New Genus: 1 > 0
Char. 127 (7 steps)
Root: 1
Node 263: 1 > 0
Node 406: 1 > 0
Bryconops affinis: 1 > 01
Node 353: 1 > 0
Astyanax mexicanus: 0 > 01
Markiana nigripinnis: 0 > 1
Moenkhausia dichroura: 1 > 0
Node 338: 1 > 01
Piabina argentea: 01 > 0
Creagrutus cf. *taphorni*: 01 > 1
Creagrutus anary: 01 > 0
Char. 128 (8 steps)
Root: 0
Node 277: 0 > 1
Node 310: 0 > 1
Attonitus ephimeros: 0 > 1
Node 389: 0 > 1
Astyanax intermedius: 0 > 1
Cheirodon troemneri: 0 > 01
Node 343: 0 > 1
Hyphessobrycon amandae: 0 > 01
Node 376: 0 > 1
Node 446: 0 > 1
Char. 129 (14 steps)
Root: 01
Node 267: 01 > 0
Engraulisoma taeniatum: 01 > 0
Node 250: 01 > 1
Node 258: 01 > 1
Node 264: 01 > 0
Chalceus macrolepidotus: 01 > 1
Bryconamericus scleroparius: 1 > 0
Markiana nigripinnis: 1 > 0
Node 324: 1 > 0
Probolodus heterostomus: 1 > 0
Cyanocharax alburnus: 0 > 01

Hemibrycon surinamensis: 0 > 01
Node 296: 1 > 01
Acestrocephalus sardina: 01 > 0
Node 318: 0 > 1
Diapoma terofali: 0 > 01
Node 401: 0 > 1
Bryconamericus cf. *rubropictus*: 0 > 01
Node 377: 1 > 0
Odontostoechus lethostigmus: 0 > 1
Grundulus cochae: 0 > 1
New Genus: 1 > 0
Char. 130 (12 steps)
Root: 0
Node 250: 0 > 1
Salminus brasiliensis: 0 > 1
Brycon orbignyanus: 0 > 1
Node 299: 0 > 01
Node 346: 0 > 1
Inpaichthys kerri: 0 > 01
Phenacogaster tegatus: 01 > 1
Charax stenopterus: 01 > 1
Prionobrama paraguayensis: 0 > 1
Aphyocharax dentatus: 0 > 01
Acestrocephalus sardina: 01 > 0
Hyphessobrycon micropterus: 0 > 01
Pseudocorynopoma doriae: 0 > 01
Hyphessobrycon werneri: 0 > 1
Hyphessobrycon rosaceus: 0 > 01
Node 433: 0 > 1
Node 408: 0 > 01
Grundulus cochae: 0 > 1
Brittanichthys axelrodi: 01 > 1
New Genus: 01 > 0
Hyphessobrycon axelrodi: 01 > 1
Char. 131 (2 steps)
Root: 0
Node 267: 0 > 1
Node 271: 0 > 1
Char. 132 (2 steps)
Root: 01
Node 249: 01 > 0
Node 242: 01 > 1
Hemiodus cf. *thayeria*: 01 > 1
Leporinus striatus: 01 > 0
Char. 133 (5 steps)
Root: 0
Stichonodon insignis: 0 > 1
Node 277: 0 > 01
Node 276: 01 > 1
Node 314: 01 > 0
Node 345: 01 > 1
Node 292: 1 > 01
Xenagoniates bondi: 01 > 0
Brittanichthys axelrodi: 0 > 1
Char. 134 (18 steps)
Root: 0
Node 244: 0 > 01
Node 248: 01 > 0
Node 242: 01 > 1
Node 261: 01 > 1
Hemiodus cf. *thayeria*: 01 > 1
Node 246: 01 > 0
Node 267: 01 > 0
Engraulisoma taeniatum: 01 > 0
Node 250: 01 > 1
Node 258: 01 > 1
Node 264: 01 > 0
Chalceus macrolepidotus: 01 > 1
Iguanodectes geisleri: 1 > 0
Bryconops alburnoides: 1 > 0
Stichonodon insignis: 1 > 0
Node 350: 1 > 0
Astyanax lineatus: 0 > 1
Node 387: 1 > 01
Hyphessobrycon elachys: 01 > 0
Parecbasis cyclolepis: 1 > 0
Hemigrammus bleheri: 1 > 01
Thayeria obliqua: 1 > 01
Moenkhausia dichroura: 1 > 01
Hasemania hanseni: 1 > 0
Hyphessobrycon amandae: 1 > 0
Aulixidens eugeniae: 1 > 0
Coptobrycon bilineatus: 1 > 0
Paracheirodon axelrodi: 1 > 01
Brittanichthys axelrodi: 1 **> 0**
Char. 135 (23 steps)
Root: 0
Node 243: 0 > 01
Node 242: 01 > 1
Node 261: 0 > 1
Hemiodus cf. *thayeria*: 01 > 1
Node 246: 01 > 0
Node 259: 0 > 01
Node 258: 01 > 1
Thoracocharax stellatus: 0 > 1
Node 264: 01 > 0
Chalceus macrolepidotus: 01 > 1
Iguanodectes geisleri: 1 > 0
Bryconops alburnoides: 1 > 0
Node 386: 1 > 0
Node 285: 1 > 0
Stethaprion erythrops: 1 > 01
Hyphessobrycon anisitsi: 0 > 01
Astyanax endy: 0 > 01
Astyanax goyanensis: 0 > 1
Node 281: 0 > 1
Hyphessobrycon bifasciatus: 0 > 01
Astyanax janeiroensis: 0 > 01
Cheirodon stenodon: 1 > 01
Hyphessobrycon boulengeri: 1 > 01
Hemigrammus tocantinsi: 1 > 01
Hyphessobrycon panamensis: 1 > 01
Moenkhausia forestii: 1 > 01
Node 388: 1 > 0
Aphyodite grammica: 1 > 01
Node 380: 1 > 0
Parecbasis cyclolepis: 1 > 0
Hemigrammus parana: 1 > 01
Hemigrammus erythrozonus: 0 > 1
Hyphessobrycon takasei: 1 > 01
Hyphessobrycon parvellus: 0 > 01
Cheirodon interruptus: 1 > 0
Moenkhausia xinguensis: 1 > 01
Bario steindachneri: 1 > 01
Moenkhausia cf. *intermedia*: 1 > 01
Moenkhausia dichroura: 1 > 01
Cheirodon troemneri: 1 > 01
Node 377: 0 > 01
Nematobrycon palmeri: 01 > 1
Aulixidens eugeniae: 1 > 0
Node 409: 0 > 01
Coptobrycon bilineatus: 01 > 0
Node 375: 01 > 1
Bryconella pallidifrons: 01 > 1
Paracheirodon innesi: 0 > 1
Node 425: 01 > 1
Brittanichthys axelrodi: 01 > 0
Char. 136 (27 steps)
Root: 0
Node 261: 0 > 1
Hemiodus cf. *thayeria*: 0 > 1
Thoracocharax stellatus: 0 > 01
Node 257: 0 > 1
Chalceus macrolepidotus: 0 > 1
Node 305: 0 > 1
Node 406: 1 > 0
Tetragonopterus argenteus: 0 > 01
Astyanax latens: 0 > 01
Node 370: 0 > 1
Astyanax paris: 0 > 01
Poptella paraguayensis: 0 > 01
Node 301: 0 > 1
Node 278: 0 > 1
Probolodus heterostomus: 0 > 01
Moenkhausia pittieri: 0 > 01
Cheirodon stenodon: 0 > 1
Node 444: 0 > 01
Node 329: 1 > 01
Cyanocharax alburnus: 1 > 01
Node 451: 0 > 1
Ectrepopterus uruguayensis: 0 > 1
Node 423: 0 > 1
Hyphessobrycon tortuguerae: 01 > 1
Rhoadsia altipinna: 1 > 01
Carlana eigenmanni: 1 > 01
Aphyodite grammica: 1 > 0
Node 313: 1 > 0
Node 328: 01 > 0
Parecbasis cyclolepis: 1 > 0
Aphyocharax anisitsi: 1 > 01
Moenkhausia sp. n.: 0 > 01
Hyphessobrycon moniliger: 0 > 01
Hemigrammus ulreyi: 1 > 01
Hemigrammus erythrozonus: 0 > 01
Bryconamericus thomasi: 1 > 01
Bryconamericus cf. *iheringii*: 1 > 01
Deuterodon singularis: 1 > 0
Node 392: 0 > 01
Hyphessobrycon socolofi: 0 > 1
Node 432: 1 > 0
Hyphessobrycon micropterus: 1 > 0
Pseudocorynopoma doriae: 1 > 01
Diapoma terofali: 1 > 01
Node 339: 1 > 01
Bryconamericus rubropictus: 1 > 01
Jupiaba scologaster: 01 > 1
Hyphessobrycon eques: 0 > 01
Nematobrycon palmeri: 0 > 1
Aulixidens eugeniae: 01 > 0
Odontostoechus lethostigmus: 01 > 1
Piabina argentea: 01 > 0
Grundulus cochae: 0 > 1
Char. 137 (15 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 257: 0 > 1
Chalceus macrolepidotus: 0 > 1
Node 305: 0 > 1
Node 406: 1 > 0
Node 370: 0 > 1
Oligosarcus argenteus: 1 > 0
Node 301: 0 > 1
Hemibrycon surinamensis: 0 > 1
Hyphessobrycon tortuguerae: 0 > 1
Rhoadsia altipinna: 1 > 01
Carlana eigenmanni: 1 > 01
Prodontocharax melanotus: 0 > 1
Node 293: 0 > 1
Parapristella georgiae: 0 > 1
Pristella maxillaris: 0 > 01
Nematobrycon palmeri: 0 > 1
Grundulus cochae: 0 > 1
Char. 138 (15 steps)
Root: 01
Node 243: 01 > 1
Node 261: 01 > 0
Node 259: 01 > 1
Node 250: 01 > 0
Node 256: 1 > 01
Node 255: 01 > 0
Node 305: 1 > 0
Oligosarcus argenteus: 1 > 0
Node 299: 1 > 0
Node 346: 1 > 0
Node 275: 1 > 01

Node 274: 01 > 0
Node 292: 01 > 1
Prionobrama paraguayensis: 01 > 0
Aphyocharacidium bolivianum: 0 > 1
Parapristella georgiae: 1 > 0
Pristella maxillaris: 1 > 0
Node 408: 1 > 01
Grundulus cochae: 1 > 0
Paracheirodon simulans: 1 > 0
Node 425: 01 > 0
Char. 139 (30 steps)
Root: 01
Node 243: 01 > 1
Node 253: 01 > 0
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Brycon orbignyanus: 0 > 1
Bryconops melanurus: 0 > 01
Bryconops affinis: 0 > 01
Node 336: 0 > 01
Bryconamericus scleroparius: 01 > 1
Node 285: 0 > 01
Node 404: 01 > 0
Bramocharax bransfordii: 01 > 1
Poptella paraguayensis: 0 > 01
Node 359: 01 > 1
Hyphessobrycon anisitsi: 01 > 0
Astyanax cf. *eigenmanniorum2*: 1 > 01
Node 352: 01 > 1
Astyanax mexicanus: 01 > 1
Node 407: 01 > 0
Hyphessobrycon togoi: 01 > 1
Astyanax endy: 1 > 01
Astyanax cf. *eigenmanniorum* 1: 1 > 01
Node 280: 01 > 0
Node 437: 01 > 1
Hyphessobrycon igneus: 01 > 0
Astyanax chico: 1 > 01
Node 400: 0 > 01
Node 418: 0 > 01
Astyanax lineatus: 1 > 01
Node 311: 0 > 1
Cheirodon stenodon: 01 > 1
Hyphessobrycon langeanii: 0 > 01
Node 452: 0 > 1
Moenkhausia forestii: 01 > 1
Node 314: 0 > 01
Hemibrycon dariensis: 0 > 1
Hyphessobrycon cachimbensis: 0 > 1
Node 382: 0 > 01
Node 313: 01 > 1
Node 328: 0 > 1
Node 380: 01 > 0
Hemigrammus tridens: 01 > 1
Hyphessobrycon loweae: 01 > 1
Node 393: 0 > 1
Hemigrammus unilineatus: 0 > 01
Hyphessobrycon rutiliflavidus: 0 > 1
Hemigrammus erythrozonus: 0 > 1
Node 331: 1 > 0
Hyphessobrycon pulchripinnis: 0 > 1
Node 432: 0 > 1
Pseudocorynopoma doriae: 0 > 01
Moenkhausia xinguensis: 0 > 01
Bario steindachneri: 0 > 01
Cheirodon aff. *troemneri*: 0 > 1
Node 343: 0 > 01
Hyphessobrycon eques: 1 > 01
Odontostoechus lethostigmus: 01 > 1
Paracheirodon axelrodi: 0 > 1
Gymnocharacinus bergii: 0 > 1
Char. 140 (1 step)
Root: 0
Node 311: 0 > 1
Char. 141 (3 steps)
Root: 0
Node 310: 0 > 1
Prodontocharax melanotus: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 142 (6 steps)
Root: 01
Node 244: 01 > 0
Distichodus maculatus: 01 > 1
Pyrrhulina australis: 0 > 1
Node 346: 0 > 1
Charax stenopterus: 0 > 1
Hyphessobrycon epicharis: 0 > 1
Node 408: 0 > 1
Grundulus cochae: 0 > 01
Char. 143 (12 steps)
Root: 0
Node 248: 0 > 1
Node 246: 0 > 1
Node 251: 0 > 1
Node 269: 0 > 1
Serrasalmus maculatus: 0 > 1
Node 305: 1 > 0
Rhaphiodon vulpinus: 0 > 1
Node 371: 1 > 0
Node 295: 1 > 01
Aphyocharacidium bolivianum: 1 > 0
Acestrocephalus sardina: 01 > 0
Galeocharax humeralis: 01 > 0
Cynopotamus argenteus: 01 > 1
New Genus: 1 > 0
Char. 144 (3 steps)
Root: 0
Node 252: 0 > 01
Node 267: 01 > 1
Node 265: 01 > 1
Node 271: 01 > 1
Node 256: 01 > 0
Node 290: 01 > 0
Char. 145 (1 step)
Root: 0
Node 266: 0 > 1
Char. 146 (1 step)
Root: 0
Axelrodia lindeae: 0 > 1
Char. 147 (3 steps)
Root: 0
Node 309: 0 > 1
Astyanax paris: 0 > 01
Node 360: 0 > 01
Astyanax cf. *rutilus*: 01 > 1
Astyanax courensis: 0 > 01
Astyanax altiparanae: 0 > 01
Pristella maxillaris: 0 > 01
Hasemania hanseni: 0 > 01
Aulixidens eugeniae: 0 > 1
Char. 148 (23 steps)
Root: 0
Node 251: 0 > 01
Engraulisoma taeniatum: 01 > 1
Thoracocharax stellatus: 01 > 0
Carnegiella strigata: 01 > 1
Node 291: 0 > 1
Brycon pesu: 0 > 01
Brycon falcatus: 0 > 01
Node 336: 1 > 0
Node 285: 1 > 0
Stichonodon insignis: 1 > 0
Node 403: 0 > 1
Astyanax janeiroensis: 0 > 1
Hyphessobrycon griemi: 0 > 1
Node 420: 0 > 1
Astyanax abramis: 0 > 01
Astyanax lineatus: 0 > 01
Astyanax cf. *asuncionensis*: 0 > 01
Node 399: 0 > 1
Pseudochalceus kyburzi: 0 > 01
Node 341: 0 > 1
Hyphessobrycon savagei: 0 > 1
Node 364: 0 > 01
Node 455: 0 > 1
Node 363: 01 > 1
Node 421: 0 > 01
Hyphessobrycon herbertaxelrodi: 0 > 1
Node 405: 0 > 1
Astyanax giton: 1 > 0
Hemigrammus parana: 01 > 1
Cheirodon jaguaribensis: 01 > 0
Hemigrammus ulreyi: 01 > 1
Jupiaba polylepis: 0 > 1
Jupiaba scologaster: 0 > 01
Hasemania hanseni: 0 > 1
Node 436: 0 > 1
Char. 149 (14 steps)
Root: 0
Node 248: 0 > 1
Node 256: 0 > 01
Salminus brasiliensis: 01 > 1
Agoniates anchovia: 01 > 0
Node 254: 01 > 1
Lonchogenys ilisha: 0 > 1
Node 391: 0 > 01
Pseudochalceus kyburzi: 01 > 1
Node 452: 0 > 01
Node 451: 01 > 1
Rhoadsia altipinna: 0 > 01
Carlana eigenmanni: 0 > 01
Node 297: 0 > 1
Node 458: 01 > 0
Node 312: 0 > 1
Astyanax hastatus: 01 > 1
Hasemania nana: 0 > 1
Astyanax intermedius: 01 > 1
Astyanax giton: 01 > 0
Node 448: 1 > 0
Odontostilbe paraguayensis: 1 > 01
Hyphessobrycon eques: 0 > 1
Grundulus cochae: 0 > 1
Char. 150 (9 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 250: 0 > 1
Node 256: 0 > 1
Node 407: 0 > 01
Node 402: 0 > 1
Astyanax courensis: 01 > 1
Node 391: 0 > 1
Hyphessobrycon tortuguerae: 0 > 01
Node 297: 0 > 1
Exodon paradoxus: 0 > 1
Hyphessobrycon moniliger: 0 > 1
Char. 151 (32 steps)
Root: 0
Node 249: 0 > 01
Characidium rachovii: 01 > 1
Characidium borellii: 01 > 0
Hemiodus cf. *thayeria*: 0 > 1
Node 260: 01 > 0
Pyrrhulina australis: 01 > 1
Engraulisoma taeniatum: 01 > 1
Cyphocharax spilotus: 0 > 1
Metynnis maculatus: 0 > 1
Node 268: 0 > 1
Micralestes stormsi: 0 > 1
Bryconops alburnoides: 0 > 1
Node 406: 0 > 1
Node 287: 0 > 01
Astyanax latens: 01 > 1
Node 386: 0 > 1
Astyanax paris: 01 > 0
Node 359: 01 > 0

Node 283: 01 > 1
Node 352: 01 > 0
Astyanax mexicanus: 01 > 1
Node 407: 01 > 1
Astyanax cf. *rutilus*: 0 > 1
Psellogrammus kennedyi: 0 > 1
Node 324: 1 > 0
Node 310: 1 > 0
Cyanocharax alburnus: 0 > 1
Node 371: 1 > 01
Node 456: 1 > 01
Deuterodon supparis: 1 > 0
Bryconexodon juruenae: 01 > 0
Bryconamericus iheringii: 0 > 1
Cyanocharax alegretensis: 0 > 1
Astyanax hastatus: 01 > 0
Astyanax intermedius: 01 > 0
Astyanax giton: 01 > 1
Node 393: 1 > 0
Node 361: 1 > 0
Pseudocorynopoma doriae: 0 > 1
Diapoma speculiferum: 0 > 1
Node 401: 0 > 1
Aulixidens eugeniae: 0 > 1
Char. 152 (7 steps)
Root: 0
Distichodus maculatus: 0 > 01
Node 246: 0 > 01
Leporinus striatus: 01 > 1
Prochilodus lineatus: 01 > 1
Cyphocharax spilotus: 01 > 0
Node 268: 0 > 1
Node 457: 0 > 1
Node 294: 0 > 1
Deuterodon rosae: 0 > 1
Node 337: 0 > 1
Char. 153 (3 steps)
Root: 1
Distichodus maculatus: 1 > 01
Node 246: 1 > 0
Node 268: 1 > 0
Node 263: 1 > 0
Char. 154 (9 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 256: 0 > 1
Node 305: 0 > 1
Brycon pesu: 0 > 01
Bryconops melanurus: 0 > 1
Node 370: 0 > 1
Oligosarcus argenteus: 1 > 0
Node 301: 0 > 1
Nematocharax venustus: 1 > 01
Rhoadsia altipinna: 1 > 01
Carlana eigenmanni: 1 > 01
Phenacogaster tegatus: 1 > 0
Bryconexodon juruenae: 1 > 0
Char. 155 (10 steps)
Root: 0
Thoracocharax stellatus: 0 > 1
Node 256: 0 > 1
Brycon orbignyanus: 0 > 01
Heterocharax macrolepis: 0 > 1
Node 403: 0 > 01
Node 402: 01 > 1
Hyphessobrycon igneus: 0 > 01
Node 301: 0 > 1
Cheirodon stenodon: 0 > 01
Nematocharax venustus: 1 > 01
Rhoadsia altipinna: 1 > 01
Carlana eigenmanni: 1 > 01
Phenacogaster tegatus: 1 > 0
Bryconexodon juruenae: 1 > 0
Roeboides descalvadensis: 1 > 0
Deuterodon langei: 0 > 1
Pristella maxillaris: 0 > 1
Hyphessobrycon werneri: 0 > 01
Hyphessobrycon hasemani: 0 > 01
New Genus: 0 > 01
Char. 156 (2 steps)
Root: 0
Engraulisoma taeniatum: 0 > 2
Aulixidens eugeniae: 0 > 1
Char. 157 (5 steps)
Root: 0
Node 250: 0 > 1
Node 265: 0 > 1
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Agoniates anchovia: 0 > 1
Attonitus ephimeros: 0 > 1
Char. 158 (1 step)
Root: 0
Node 268: 0 > 1
Char. 159 (8 steps)
Root: 0
Distichodus maculatus: 0 > 1
Node 248: 0 > 1
Hoplias cf. *malabaricus*: 0 > 1
Serrasalmus maculatus: 0 > 1
Acestrorhynchus pantaneiro: 0 > 1
Node 404: 0 > 1
Xenagoniates bondi: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 160 (2 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Char. 161 (6 steps)
Root: 0
Node 257: 0 > 01
Brycon orbignyanus: 01 > 1
Agoniates anchovia: 01 > 0
Node 254: 01 > 1
Node 404: 0 > 01
Oligosarcus sp. n.: 01 > 1
Oligosarcus argenteus: 01 > 0
Node 402: 01 > 1
Node 296: 0 > 1
Exodon paradoxus: 0 > 1
Deuterodon langei: 0 > 01
Jupiaba scologaster: 0 > 01
Jupiaba mucronata: 0 > 01
Char. 162 (12 steps)
Root: 0
Engraulisoma taeniatum: 0 > 1
Node 264: 0 > 1
Stichonodon insignis: 0 > 1
Astyanax troya: 0 > 01
Hyphessobrycon boulengeri: 0 > 1
Node 323: 0 > 1
Hyphessobrycon panamensis: 0 > 1
Node 314: 0 > 1
Phenacogaster tegatus: 0 > 01
Odontostilbe pequira: 1 > 01
Prionobrama paraguayensis: 0 > 1
Node 449: 0 > 1
Hyphessobrycon herbertaxelrodi: 0 > 01
Aphyocharax dentatus: 0 > 1
Acrobrycon tarijae: 1 > 01
Hemigrammus unilineatus: 0 > 01
Thayeria boehlkei: 0 > 01
Microschemobrycon casiquiare: 0 > 1
Node 318: 1 > 01
Bryconamericus thomasi: 1 > 01
Bryconamericus cf. *iheringii*: 1 > 01
Deuterodon iguape: 1 > 01
Cheirodon interruptus: 1 > 01
Pseudocorynopoma doriae: 01 > 0
Bryconamericus rubropictus: 1 > 01
Bryconamericus cf. *rubropictus*: 1 > 01
Jupiaba scologaster: 0 > 01
Nantis cf. *indefessus*: 1 > 01
Nantis indefessus: 1 > 01
Coptobrycon bilineatus: 0 > 01
New Genus: 0 > 01
Char. 163 (17 steps)
Root: 0
Node 242: 0 > 1
Hoplias cf. *malabaricus*: 0 > 1
Piaractus mesopotamicus: 0 > 1
Carnegiella strigata: 0 > 01
Node 305: 0 > 1
Bryconops alburnoides: 0 > 01
Node 254: 0 > 1
Hyphessobrycon bifasciatus: 0 > 01
Cheirodon stenodon: 0 > 1
Hyphessobrycon boulengeri: 0 > 01
Node 298: 0 > 1
Ectrepopterus uruguayensis: 0 > 01
Astyanax ribeirae: 0 > 01
Node 455: 0 > 1
Hyphessobrycon herbertaxelrodi: 0 > 01
Hyphessobrycon heliacus: 0 > 1
Axelrodia lindeae: 0 > 01
Hemigrammus parana: 0 > 01
Hemigrammus ulreyi: 0 > 01
Node 413: 0 > 01
Node 445: 0 > 01
Hyphessobrycon micropterus: 0 > 1
Hyphessobrycon parvellus: 01 > 1
Hyphessobrycon negodagua: 0 > 01
Knodus moenkhausii: 01 > 1
Hyphessobrycon ecuadoriensis: 01 > 1
Node 433: 0 > 01
Hyphessobrycon amandae: 01 > 0
Hyphessobrycon hasemani: 0 > 1
Hyphessobrycon epicharis: 01 > 1
Bryconella pallidifrons: 01 > 1
Paracheirodon simulans: 01 > 0
Node 425: 01 > 0
Brittanichthys axelrodi: 01 > 1
Char. 164 (6 steps)
Root: 0
Node 248: 0 > 1
Node 246: 0 > 01
Apareiodon affinis: 0 > 1
Pyrrhulina australis: 0 > 1
Node 245: 01 > 1
Cheirodon stenodon: 0 > 01
Node 314: 0 > 1
Inpaichthys kerri: 0 > 1
Odontostilbe pequira: 1 > 01
Cheirodon aff. *troemneri*: 0 > 01
Cheirodon troemneri: 0 > 01
Brittanichthys axelrodi: 0 > 01
Char. 165 (2 steps)
Root: 0
Distichodus maculatus: 0 > 01
Node 254: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 166 (1 step)
Root: 0
Node 406: 0 > 1
Char. 167 (1 step)
Root: 0
Puntius tetrazona: 0 > 01
Node 268: 0 > 1
Char. 168 (16 steps)
Root: 0
Node 244: 0 > 2
Node 246: 2 > 0
Node 290: 2 > 1
Salminus brasiliensis: 2 > 1
Hoplocharax goethei: 1 > 12

Heterocharax macrolepis: 1 > 12
Bryconamericus scleroparius: 1 > 2
Node 407: 1 > 2
Node 420: 1 > 2
Moenkhausia hemigrammoides: 1 > 12
Hasemania kalunga: 1 > 2
Node 444: 1 > 2
Ectrepopterus uruguayensis: 1 > 2
Astyanax hastatus: 1 > 2
Axelrodia lindeae: 1 > 12
Hyphessobrycon rutiliflavidus: 1 > 12
Hemigrammus bleheri: 1 > 12
Node 415: 1 > 2
Node 412: 1 > 2
Knodus moenkhausii: 1 > 12
Knodus meridae: 1 > 12
Pseudocorynopoma doriae: 1 > 2
Node 426: 1 > 2
Node 438: 1 > 2
Hyphessobrycon werneri: 2 > 12
Char. 169 (2 steps)
Root: 0
Node 267: 0 > 1
Prochilodus lineatus: 0 > 1
Char. 170 (27 steps)
Root: 01
Puntius tetrazona: 01 > 1
Distichodus maculatus: 01 > 0
Node 249: 01 > 1
Node 243: 01 > 0
Hoplias cf. *malabaricus*: 1 > 0
Node 267: 1 > 0
Cyphocharax spilotus: 0 > 1
Node 257: 1 > 01
Node 270: 01 > 0
Salminus brasiliensis: 01 > 0
Node 305: 1 > 01
Node 406: 01 > 1
Brycon orbignyanus: 01 > 0
Agoniates anchovia: 01 > 1
Rhaphiodon vulpinus: 01 > 1
Acestrorhynchus pantaneiro: 01 > 0
Heterocharax macrolepis: 01 > 0
Node 404: 1 > 0
Oligosarcus cf. *jenynsii*: 0 > 1
Markiana nigripinnis: 1 > 01
Node 431: 1 > 0
Astyanax asuncionensis: 1 > 01
Astyanax cf. *abramis*: 1 > 01
Astyanax abramis: 1 > 0
Moenkhausia hemigrammoides: 1 > 01
Hasemania kalunga: 1 > 01
Hemigrammus ocellifer: 1 > 0
Moenkhausia sanctaefilomenae: 1 > 0
Hyphessobrycon savagei: 1 > 0
Node 296: 1 > 01
Astyanax hastatus: 1 > 0
Node 295: 01 > 0
Astyanax taeniatus: 1 > 0
Hyphessobrycon moniliger: 1 > 01
Hemigrammus unilineatus: 1 > 01
Parapristella georgiae: 1 > 0
Roeboides descalvadensis: 01 > 1
Roeboides microlepis: 01 > 0
Hyphessobrycon takasei: 1 > 0
Hyphessobrycon pulchripinnis: 1 > 01
Hyphessobrycon micropterus: 1 > 01
Hyphessobrycon parvellus: 1 > 0
Moenkhausia xinguensis: 1 > 01
Hyphessobrycon copelandi: 1 > 01
Hyphessobrycon werneri: 1 > 01
Hyphessobrycon rosaceus: 1 > 0
Hyphessobrycon minor: 1 > 0
Hyphessobrycon pyrrhonotus: 1 > 01
Creagrutus cf. *taphorni*: 1 > 0
Char. 171 (15 steps)
Root: 1
Node 249: 1 > 0
Hemiodus cf. *thayeria*: 1 > 0
Node 291: 0 > 01
Node 374: 01 > 1
Node 288: 01 > 0
Tetragonopterus argenteus: 01 > 1
Lonchogenys ilisha: 01 > 1
Poptella paraguayensis: 01 > 0
Hyphessobrycon igneus: 0 > 01
Node 301: 0 > 01
Node 277: 0 > 01
Pseudochalceus kyburzi: 01 > 0
Hollandichthys multifasciatus: 01 > 1
Node 310: 01 > 1
Node 346: 01 > 1
Inpaichthys kerri: 01 > 1
Node 275: 01 > 0
Node 388: 0 > 1
Phenacogaster tegatus: 01 > 1
Node 371: 01 > 0
Prodontocharax melanotus: 01 > 1
Charax stenopterus: 01 > 1
Node 296: 01 > 0
Node 312: 01 > 0
Hemigrammus ulreyi: 0 > 01
Hemigrammus bleheri: 1 > 01
Hyphessobrycon socolofi: 0 > 01
Hyphessobrycon pulchripinnis: 0 > 01
Pristella maxillaris: 0 > 1
Moenkhausia cf. *intermedia*: 0 > 1
Hyphessobrycon eques: 0 > 01
Paracheirodon axelrodi: 0 > 01
Bryconella pallidifrons: 0 > 01
Char. 172 (21 steps)
Root: 1
Hoplias cf. *malabaricus*: 1 > 0
Node 259: 1 > 01
Node 257: 01 > 0
Node 264: 01 > 1
Chalceus macrolepidotus: 01 > 0
Node 291: 01 > 0
Node 268: 01 > 1
Node 406: 0 > 1
Node 351: 0 > 01
Astyanax pelegrini: 01 > 1
Node 349: 01 > 0
Psellogrammus kennedyi: 01 > 1
Node 278: 0 > 01
Node 277: 01 > 1
Astyanax lineatus: 0 > 1
Node 323: 01 > 1
Node 341: 01 > 0
Node 321: 1 > 01
Aphyocharax nattereri: 1 > 0
Bryconamericus iheringii: 1 > 0
Cyanocharax alegretensis: 01 > 0
Parecbasis cyclolepis: 1 > 0
Node 319: 01 > 1
Acrobrycon tarijae: 01 > 0
Node 445: 1 > 0
Cheirodon interruptus: 1 > 0
Bryconamericus exodon: 1 > 0
Nematobrycon palmeri: 0 > 1
Piabina argentea: 1 > 0
Grundulus cochae: 0 > 1
Char. 173 (3 steps)
Root: 0
Astyanax asuncionensis: 0 > 01
Astyanax cf. *abramis*: 0 > 01
Node 341: 0 > 1
Acrobrycon tarijae: 0 > 1
Knodus moenkhausii: 0 > 1
Bryconamericus exodon: 0 > 01
Bryconamericus cf. *exodon*: 0 > 01
Mimagoniates rheocharis: 0 > 01
Diapoma terofali: 0 > 01
Char. 174 (1 step)
Root: 1
Node 305: 1 > 0
Char. 175 (7 steps)
Root: 1
Node 244: 1 > 0
Node 406: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Node 404: 0 > 01
Node 403: 01 > 1
Astyanax troya: 0 > 01
Markiana nigripinnis: 0 > 1
Node 296: 0 > 01
Node 295: 01 > 1
Roeboides descalvadensis: 01 > 0
Roeboides microlepis: 01 > 1
Microschemobrycon casiquiare: 0 > 01
Galeocharax humeralis: 1 > 01
Creagrutus anary: 0 > 01
Char. 176 (2 steps)
Root: 0
Node 404: 0 > 1
Markiana nigripinnis: 0 > 1
Char. 177 (1 step)
Root: 0
Node 255: 0 > 1
Heterocharax macrolepis: 0 > 01
Char. 178 (1 step)
Root: 0
Piabucus melanostomus: 0 > 01
Node 289: 0 > 1
Hoplocharax goethei: 0 > 01
Char. 179 (7 steps)
Root: 0
Node 247: 0 > 1
Pyrrhulina australis: 0 > 01
Node 269: 0 > 1
Micralestes stormsi: 0 > 1
Salminus brasiliensis: 0 > 1
Brycon pesu: 0 > 01
Brycon orbignyanus: 0 > 1
Hoplocharax goethei: 1 > 01
Heterocharax macrolepis: 1 > 01
Stichonodon insignis: 1 > 0
Node 297: 1 > 0
Char. 180 (2 steps)
Root: 0
Node 312: 0 > 1
Aphyocharax dentatus: 0 > 01
Hyphessobrycon amandae: 0 > 01
Paracheirodon axelrodi: 0 > 01
Paracheirodon innesi: 0 > 1
Char. 181 (4 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Salminus brasiliensis: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Node 295: 0 > 1
Char. 182 (2 steps)
Root: 1
Node 243: 1 > 0
Thoracocharax stellatus: 1 > 0
Char. 183 (10 steps)
Root: 0
Distichodus maculatus: 0 > 1
Node 248: 0 > 1
Hemiodus cf. *thayeria*: 0 > 1
Hoplias cf. *malabaricus*: 0 > 1
Node 257: 0 > 1
Chalceus macrolepidotus: 0 > 1
Node 374: 0 > 1
Agoniates anchovia: 1 > 0

Node 304: 0 > 1
Piabina argentea: 0 > 1
Char. 184 (19 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Pyrrhulina australis: 1 > 0
Node 267: 1 > 0
Node 264: 1 > 01
Micralestes stormsi: 01 > 0
Piabucus melanostomus: 1 > 0
Hoplocharax goethei: 1 > 0
Rhaphiodon vulpinus: 1 > 0
Node 299: 1 > 01
Hollandichthys multifasciatus: 1 > 0
Node 372: 01 > 0
Node 297: 01 > 0
Phenacogaster tegatus: 01 > 1
Cyanocharax alegretensis: 1 > 01
Attonitus ephimeros: 1 > 0
Axelrodia lindeae: 1 > 0
Xenagoniates bondi: 1 > 0
Cynopotamus argenteus: 0 > 1
Jupiaba scologaster: 1 > 0
Node 377: 1 > 01
Node 337: 1 > 01
Coptobrycon bilineatus: 01 > 0
Creagrutus anary: 01 > 0
Bryconella pallidifrons: 1 > 0
Gymnocharacinus bergii: 01 > 0
Grundulus cochae: 01 > 1
Char. 185 (19 steps)
Root: 1
Node 248: 1 > 0
Node 250: 1 > 0
Node 255: 1 > 01
Node 289: 1 > 0
Node 406: 1 > 0
Agoniates anchovia: 01 > 0
Rhaphiodon vulpinus: 01 > 1
Acestrorhynchus pantaneiro: 01 > 0
Poptella paraguayensis: 0 > 01
Astyanax cf. *eigenmanniorum1*: 0 > 01
Node 301: 0 > 01
Astyanax cf. *asuncionensis*: 0 > 01
Probolodus heterostomus: 0 > 01
Pseudochalceus kyburzi: 01 > 0
Hollandichthys multifasciatus: 01 > 1
Hyphessobrycon langeanii: 0 > 01
Nematocharax venustus: 01 > 1
Node 310: 01 > 0
Node 372: 01 > 1
Node 297: 01 > 1
Phenacogaster tegatus: 01 > 0
Prodontocharax melanotus: 0 > 1
Node 440: 0 > 01
Exodon paradoxus: 1 > 01
Axelrodia lindeae: 0 > 1
Hyphessobrycon moniliger: 0 > 01
Hemigrammus unilineatus: 0 > 01
Parapristella georgiae: 01 > 1
Node 413: 0 > 01
Deuterodon iguape: 0 > 01
Node 392: 0 > 1
Bryconamericus exodon: 0 > 01
Mimagoniates rheocharis: 0 > 1
Cheirodon troemneri: 0 > 01
Node 410: 01 > 1
Node 337: 0 > 01
Creagrutus anary: 01 > 1
Gymnocharacinus bergii: 0 > 1
Node 425: 1 > 01
Hyphessobrycon axelrodi: 01 > 0
Char. 186 (1 step)
Root: 0
Node 293: 0 > 1
Char. 187 (2 steps)
Root: 0
Node 255: 0 > 01
Agoniates anchovia: 01 > 1
Rhaphiodon vulpinus: 01 > 0
Acestrorhynchus pantaneiro: 01 > 1
Char. 188 (23 steps)
Root: 01
Node 244: 01 > 0
Distichodus maculatus: 01 > 1
Node 259: 0 > 01
Node 257: 01 > 0
Metynnis maculatus: 0 > 1
Micralestes stormsi: 01 > 1
Node 290: 01 > 0
Node 374: 01 > 1
Piabucus melanostomus: 01 > 1
Node 308: 0 > 01
Astyanax latens: 0 > 01
Poptella paraguayensis: 01 > 1
Node 359: 0 > 1
Node 403: 0 > 01
Astyanax cf. *eigenmanniorum2*: 1 > 01
Node 352: 0 > 01
Node 402: 01 > 1
Astyanax endy: 1 > 01
Astyanax correntinus: 01 > 1
Astyanax pelegrini: 01 > 1
Hyphessobrycon bifasciatus: 0 > 01
Node 349: 01 > 0
Astyanax troya: 1 > 01
Hollandichthys multifasciatus: 0 > 01
Hyphessobrycon langeanii: 0 > 01
Hemigrammus ocellifer: 0 > 01
Moenkhausia sanctaefilomenae: 0 > 01
Nematocharax venustus: 0 > 01
Node 346: 0 > 01
Node 457: 0 > 01
Hyphessobrycon savagei: 0 > 01
Attonitus ephimeros: 0 > 1
Astyanax ribeirae: 01 > 1
Hyphessobrycon luetkenii: 01 > 0
Astyanax hastatus: 01 > 1
Node 363: 0 > 01
Node 405: 0 > 01
Hasemania nana: 0 > 01
Node 396: 01 > 1
Axelrodia lindeae: 01 > 0
Aphyocharacidium bolivianum: 01 > 1
Odontostilbe microcephala: 0 > 1
Astyanax intermedius: 01 > 0
Astyanax giton: 01 > 1
Hyphessobrycon moniliger: 0 > 01
Thayeria boehlkei: 01 > 1
Roeboides descalvadensis: 0 > 1
Node 325: 0 > 1
Deuterodon singularis: 0 > 1
Node 398: 01 > 1
Hyphessobrycon socolofi: 0 > 01
Cheirodon interruptus: 0 > 01
Jupiaba scologaster: 0 > 1
Hyphessobrycon axelrodi: 0 > 01
Char. 189 (8 steps)
Root: 1
Node 253: 1 > 01
Node 252: 01 > 0
Pyrrhulina australis: 01 > 0
Hoplias cf. *malabaricus*: 01 > 1
Node 265: 0 > 1
Carnegiella strigata: 0 > 1
Node 255: 0 > 1
Node 305: 0 > 1
Node 406: 0 > 1
Bryconops affinis: 0 > 1
Char. 190 (2 steps)
Root: 1
Node 250: 1 > 0
Node 406: 1 > 0
Char. 191 (7 steps)
Root: 0
Cyphocharax spilotus: 0 > 1
Probolodus heterostomus: 0 > 01
Prodontocharax melanotus: 0 > 1
Node 333: 0 > 01
Node 332: 01 > 1
Thayeria obliqua: 0 > 1
Node 317: 0 > 01
Node 340: 01 > 0
Node 334: 01 > 1
Pristella maxillaris: 0 > 01
Serrapinnus calliurus: 01 > 1
Bryconamericus cf. *exodon*: 0 > 01
Diapoma speculiferum: 0 > 01
Aulixidens eugeniae: 0 > 1
Paracheirodon axelrodi: 0 > 01
Char. 192 (20 steps)
Root: 1
Node 259: 1 > 0
Node 250: 1 > 0
Node 268: 0 > 1
Brycon orbignyanus: 0 > 1
Bryconaethiops macrops: 0 > 1
Hoplocharax goethei: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Cyanocharax alburnus: 0 > 01
Carlana eigenmanni: 0 > 1
Prodontocharax melanotus: 0 > 1
Node 328: 0 > 1
Node 326: 0 > 1
Hyphessobrycon elachys: 0 > 1
Parecbasis cyclolepis: 0 > 1
Odontostilbe microcephala: 0 > 1
Node 445: 1 > 01
Node 331: 1 > 0
Cheirodon interruptus: 0 > 1
Knodus moenkhausii: 01 > 0
Node 339: 1 > 01
Node 338: 01 > 0
Node 376: 0 > 01
Aulixidens eugeniae: 01 > 0
Odontostoechus lethostigmus: 01 > 1
Node 375: 01 > 1
Char. 193 (24 steps)
Root: 1
Node 259: 1 > 01
Node 257: 01 > 0
Node 264: 01 > 1
Chalceus macrolepidotus: 01 > 0
Node 291: 01 > 0
Node 268: 01 > 1
Brycon orbignyanus: 0 > 1
Hoplocharax goethei: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Node 315: 0 > 01
Node 323: 0 > 1
Node 310: 0 > 1
Node 346: 01 > 1
Node 371: 0 > 1
Prodontocharax melanotus: 01 > 1
Bryconamericus mennii: 1 > 0
Odontostilbe pequira: 01 > 0
Node 320: 1 > 0
Hyphessobrycon elachys: 0 > 1
Node 295: 0 > 1
Axelrodia lindeae: 1 > 0
Odontostilbe microcephala: 01 > 1
Microschemobrycon melanotus: 1 > 0
Odontostilbe paraguayensis: 01 > 0
Node 398: 0 > 1

Pristella maxillaris: 0 > 01
Cheirodon interruptus: 01 > 1
Serrapinnus calliurus: 01 > 0
Bryconamericus exodon: 1 > 0
Diapoma terofali: 0 > 1
Node 377: 0 > 1
Node 338: 1 > 0
Char. 194 (1 step)
Root: 1
Acestrorhynchus pantaneiro: 1 > 0
Char. 195 (16 steps)
Root: 01
Puntius tetrazona: 01 > 1
Distichodus maculatus: 01 > 0
Node 249: 01 > 1
Node 243: 01 > 0
Hoplias cf. *malabaricus*: 1 > 0
Leporinus striatus: 0 > 1
Piaractus mesopotamicus: 1 > 0
Node 257: 1 > 0
Node 263: 1 > 0
Brycon pesu: 0 > 1
Astyanax latens: 1 > 0
Stichonodon insignis: 1 > 0
Astyanax cf. *rutilus*: 1 > 0
Astyanax pelegrini: 1 > 0
Astyanax cf. *abramis*: 1 > 01
Astyanax abramis: 1 > 01
Prodontocharax melanotus: 1 > 01
Parecbasis cyclolepis: 1 > 0
Hyphessobrycon compressus: 1 > 01
Hyphessobrycon socolofi: 1 > 0
Moenkhausia dichroura: 1 > 0
Hyphessobrycon rosaceus: 1 > 01
Hyphessobrycon epicharis: 1 > 01
Brittanichthys axelrodi: 1 > 0
Char. 196 (35 steps)
Root: 01
Puntius tetrazona: 01 > 1
Distichodus maculatus: 01 > 0
Node 243: 01 > 0
Node 248: 01 > 1
Node 260: 01 > 0
Pyrrhulina australis: 01 > 1
Hoplias cf. *malabaricus*: 01 > 0
Engraulisoma taeniatum: 01 > 1
Thoracocharax stellatus: 01 > 0
Carnegiella strigata: 01 > 1
Micralestes stormsi: 0 > 01
Node 374: 0 > 01
Iguanodectes geisleri: 0 > 1
Bryconops alburnoides: 01 > 1
Hoplocharax goethei: 0 > 01
Bryconops melanurus: 01 > 1
Bryconops affinis: 01 > 0
Bryconamericus scleroparius: 0 > 01
Hyphessobrycon anisitsi: 0 > 01
Astyanax courensis: 0 > 01
Hyphessobrycon bifasciatus: 0 > 01
Hyphessobrycon griemi: 0 > 01
Astyanax troya: 0 > 01
Node 278: 0 > 01
Node 400: 0 > 1
Node 300: 0 > 1
Moenkhausia hemigrammoides: 1 > 01
Hollandichthys multifasciatus: 0 > 01
Hasemania kalunga: 0 > 1
Hemigrammus ocellifer: 0 > 1
Node 315: 01 > 0
Hyphessobrycon panamensis: 0 > 01
Inpaichthys kerri: 01 > 1
Cyanocharax alburnus: 01 > 0
Hemibrycon dariensis: 01 > 1
Ectrepopterus uruguayensis: 0 > 01
Rhoadsia altipinna: 1 > 0
Node 274: 01 > 1
Bryconamericus mennii: 01 > 1
Node 321: 01 > 0
Node 326: 01 > 1
Node 344: 0 > 1
Prionobrama paraguayensis: 01 > 0
Node 327: 01 > 1
Bryconamericus iheringii: 01 > 0
Hyphessobrycon herbertaxelrodi: 0 > 1
Hemigrammus tridens: 0 > 1
Node 389: 0 > 01
Hasemania nana: 0 > 01
Node 306: 1 > 01
Node 316: 0 > 01
Node 294: 01 > 1
Paragoniates alburnus: 01 > 0
Hyphessobrycon moniliger: 0 > 01
Hemigrammus unilineatus: 0 > 01
Hemigrammus ulreyi: 0 > 01
Hemigrammus erythrozonus: 01 > 1
Thayeria boehlkei: 0 > 01
Roeboides microlepis: 01 > 0
Microschemobrycon casiquiare: 0 > 1
Odontostilbe paraguayensis: 01 > 1
Bryconamericus cf. *iheringii*: 1 > 0
Node 392: 0 > 01
Hyphessobrycon pulchripinnis: 0 > 01
Galeocharax humeralis: 1 > 01
Cynopotamus argenteus: 1 > 01
Cheirodon interruptus: 01 > 0
Serrapinnus calliurus: 01 > 1
Bryconamericus cf. *exodon*: 1 > 0
Mimagoniates rheocharis: 0 > 01
Bryconamericus rubropictus: 1 > 01
Jupiaba scologaster: 01 > 1
Cheirodon aff. *troemneri*: 0 > 01
Node 338: 1 > 01
Hyphessobrycon amandae: 0 > 1
Nematobrycon palmeri: 0 > 01
Odontostoechus lethostigmus: 1 > 01
Piabina argentea: 01 > 0
Coptobrycon bilineatus: 0 > 01
Creagrutus cf. *taphorni*: 01 > 1
Creagrutus anary: 01 > 0
Grundulus cochae: 0 > 01
Paracheirodon innesi: 0 > 1
New Genus: 0 > 01
Char. 197 (2 steps)
Root: 0
Node 242: 0 > 1
Node 254: 0 > 2
Char. 198 (1 step)
Root: 0
Node 303: 0 > 1
Char. 199 (5 steps)
Root: 0
Node 246: 0 > 1
Hoplias cf. *malabaricus*: 0 > 1
Node 267: 0 > 1
Node 257: 0 > 1
Agoniates anchovia: 1 > 0
Char. 200 (5 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 256: 0 > 1
Node 403: 0 > 1
Hollandichthys multifasciatus: 0 > 01
Node 298: 0 > 1
Prionobrama paraguayensis: 0 > 1
Pristella maxillaris: 0 > 01
Char. 201 (16 steps)
Root: 1
Node 253: 1 > 01
Node 252: 01 > 0
Pyrrhulina australis: 01 > 1
Hoplias cf. *malabaricus*: 01 > 0
Hyphessobrycon griemi: 0 > 01
Pseudochalceus kyburzi: 0 > 1
Cheirodon stenodon: 0 > 1
Hemigrammus tocantinsi: 0 > 1
Hyphessobrycon panamensis: 0 > 1
Hyphessobrycon cachimbensis: 0 > 01
Node 381: 0 > 1
Bryconamericus iheringii: 0 > 01
Cyanocharax alegretensis: 0 > 1
Attonitus ephimeros: 0 > 1
Hyphessobrycon herbertaxelrodi: 0 > 1
Hyphessobrycon elachys: 0 > 1
Axelrodia lindeae: 0 > 1
Hemigrammus unilineatus: 0 > 01
Hemigrammus bleheri: 0 > 01
Node 445: 0 > 01
Hyphessobrycon parvellus: 1 > 01
Cheirodon interruptus: 0 > 01
Knodus moenkhausii: 01 > 1
Bryconamericus exodon: 0 > 01
Node 339: 0 > 01
Node 338: 01 > 1
Aulixidens eugeniae: 01 > 1
Odontostoechus lethostigmus: 01 > 0
Paracheirodon axelrodi: 1 > 01
Brittanichthys axelrodi: 1 > 0
Char. 202 (22 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 267: 0 > 01
Piaractus mesopotamicus: 01 > 1
Node 257: 0 > 1
Serrasalmus maculatus: 01 > 1
Metynnis maculatus: 01 > 0
Node 373: 0 > 1
Node 406: 1 > 0
Node 309: 0 > 01
Node 304: 0 > 1
Tetragonopterus argenteus: 01 > 1
Node 370: 0 > 1
Stichonodon insignis: 01 > 0
Gymnocorymbus ternetzi: 01 > 1
Stethaprion erythrops: 01 > 0
Poptella paraguayensis: 01 > 1
Node 357: 0 > 1
Astyanax correntinus: 0 > 1
Astyanax courensis: 0 > 01
Node 299: 0 > 01
Hollandichthys multifasciatus: 0 > 1
Node 298: 01 > 1
Roeboexodon geryi: 01 > 0
Node 371: 01 > 1
Node 395: 0 > 1
Node 428: 0 > 1
Parapristella georgiae: 0 > 1
Microschemobrycon melanotus: 0 > 1
Node 392: 1 > 01
Hyphessobrycon socolofi: 1 > 01
Hyphessobrycon pulchripinnis: 1 > 01
Hyphessobrycon micropterus: 1 > 01
Moenkhausia xinguensis: 0 > 01
Jupiaba mucronata: 01 > 0
Cheirodon aff. *troemneri*: 1 > 01
Cheirodon troemneri: 1 > 01
Hyphessobrycon haraldschultzi: 1 > 01
Brittanichthys axelrodi: 0 > 1
Char. 203 (2 steps)
Root: 1
Node 256: 1 > 0
Rhaphiodon vulpinus: 0 > 1
Char. 204 (7 steps)
Root: 1
Node 249: 1 > 01
Node 248: 01 > 0

Node 261: 01 > 1
Node 251: 01 > 0
Node 259: 01 > 1
Piaractus mesopotamicus: 01 > 0
Serrasalmus maculatus: 01 > 1
Metynnis maculatus: 01 > 0
Node 268: 1 > 0
Axelrodia lindeae: 1 > 0
Node 337: 1 > 0
Char. 205 (1 step)
Root: 0
Node 245: 0 > 1
Char. 206 (7 steps)
Root: 01
Puntius tetrazona: 01 > 1
Distichodus maculatus: 01 > 0
Node 249: 01 > 0
Hemiodus cf. *thayeria*: 01 > 0
Node 246: 01 > 1
Parodon nasus: 01 > 1
Node 251: 0 > 1
Piaractus mesopotamicus: 0 > 1
Iguanodectes geisleri: 0 > 01
Brycon pesu: 0 > 01
Pseudocorynopoma doriae: 0 > 01
Node 338: 0 > 01
Piabina argentea: 01 > 1
Creagrutus cf. *taphorni*: 01 > 1
Creagrutus anary: 01 > 0
Char. 207 (1 step)
Root: 0
Node 246: 0 > 1
Char. 208 (1 step)
Root: 0
Node 245: 0 > 1
Char. 209 (1 step)
Root: 1
Node 246: 1 > 0
Char. 210 (2 steps)
Root: 0
Engraulisoma taeniatum: 0 > 1
Aulixidens eugeniae: 0 > 1
Char. 211 (4 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 254: 0 > 1
Pseudochalceus kyburzi: 0 > 1
Node 297: 0 > 1
Char. 212 (5 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Apareiodon affinis: 1 > 0
Pyrrhulina australis: 1 > 0
Leporinus striatus: 1 > 0
Engraulisoma taeniatum: 1 > 0
Char. 213 (5 steps)
Root: 0
Characidium borellii: 0 > 1
Hoplias cf. *malabaricus*: 0 > 1
Piaractus mesopotamicus: 0 > 1
Thoracocharax stellatus: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Astyanax cf. *asuncionensis*: 0 > 01
Cyanocharax alburnus: 0 > 01
Knodus breviceps: 0 > 01
Nantis cf. *indefessus*: 0 > 01
Char. 214 (4 steps)
Root: 0
Rhaphiodon vulpinus: 0 > 1
Node 298: 0 > 1
Node 344: 0 > 1
Astyanax giton: 0 > 1
Char. 215 (1 step)
Root: 0
Node 406: 0 > 1
Char. 216 (1 step)
Root: 0
Node 297: 0 > 1
Char. 217 (1 step)
Root: 0
Node 254: 0 > 1
Char. 218 (3 steps)
Root: 0
Node 269: 0 > 1
Brycon pesu: 0 > 1
Node 458: 1 > 0
Galeocharax humeralis: 1 > 01
Char. 219 (13 steps)
Root: 0
Hemiodus cf. *thayeria*: 0 > 1
Node 259: 0 > 01
Engraulisoma taeniatum: 0 > 1
Node 265: 01 > 1
Node 257: 01 > 0
Node 374: 01 > 1
Piabucus melanostomus: 01 > 0
Iguanodectes geisleri: 01 > 1
Node 289: 01 > 0
Node 406: 0 > 1
Agoniates anchovia: 0 > 1
Heterocharax macrolepis: 01 > 1
Cyanocharax alburnus: 0 > 1
Roeboexodon geryi: 0 > 1
Bryconexodon juruenae: 0 > 01
Node 397: 0 > 1
Cyanocharax alegretensis: 0 > 1
Thayeria obliqua: 0 > 1
Diapoma speculiferum: 0 > 01
Moenkhausia xinguensis: 0 > 01
Odontostoechus lethostigmus: 0 > 01
Char. 220 (3 steps)
Root: 0
Distichodus maculatus: 0 > 01
Characidium rachovii: 0 > 01
Hemiodus cf. *thayeria*: 0 > 1
Node 260: 0 > 1
Rhaphiodon vulpinus: 1 > 0
Char. 221 (2 steps)
Root: 1
Node 269: 1 > 0
Brycon pesu: 1 > 01
Oligosarcus sp. n.: 0 > 01
Astyanax cf. *rutilus*: 0 > 01
Hollandichthys multifasciatus: 0 > 01
Node 298: 0 > 1
Carlana eigenmanni: 0 > 01
Moenkhausia dichroura: 0 > 01
Creagrutus anary: 0 > 01
Char. 222 (1 step)
Root: 0
Node 244: 0 > 1
Char. 223 (3 steps)
Root: 0
Node 305: 0 > 1
Node 406: 0 > 1
Agoniates anchovia: 0 > 1
Char. 224 (3 steps)
Root: 0
Stichonodon insignis: 0 > 1
Parecbasis cyclolepis: 0 > 1
Node 398: 0 > 1
Char. 225 (1 step)
Root: 0
Node 267: 0 > 1
Char. 226 (7 steps)
Root: 0
Node 252: 0 > 1
Engraulisoma taeniatum: 1 > 01
Chalceus macrolepidotus: 1 > 0
Node 268: 1 > 01
Node 256: 1 > 01
Piabucus melanostomus: 01 > 0
Brycon meeki: 1 > 01
Salminus brasiliensis: 01 > 0
Brycinus carolinae: 1 > 0
Agoniates anchovia: 01 > 1
Node 254: 01 > 0
Node 375: 1 > 01
Gymnocharacinus bergii: 01 > 0
Char. 227 (9 steps)
Root: 0
Puntius tetrazona: 0 > 01
Distichodus maculatus: 0 > 01
Hemiodus cf. *thayeria*: 0 > 1
Apareiodon affinis: 0 > 1
Hoplias cf. *malabaricus*: 0 > 01
Prochilodus lineatus: 0 > 1
Node 258: 0 > 1
Node 290: 1 > 0
Brycon pesu: 1 > 0
Node 406: 1 > 0
Node 294: 0 > 1
Node 303: 0 > 01
Cynopotamus argenteus: 01 > 1
Char. 228 (9 steps)
Root: 0
Node 252: 0 > 01
Characidium rachovii: 0 > 1
Node 251: 01 > 1
Node 259: 01 > 0
Node 267: 01 > 1
Cyphocharax spilotus: 0 > 1
Node 291: 0 > 01
Micralestes stormsi: 0 > 1
Node 290: 01 > 1
Iguanodectes geisleri: 0 > 01
Bryconops alburnoides: 01 > 1
Node 373: 01 > 0
Triportheus pantanensis: 0 > 1
Acestrorhynchus pantaneiro: 0 > 1
Acrobrycon tarijae: 1 > 01
Char. 229 (21 steps)
Root: 0
Engraulisoma taeniatum: 0 > 1
Metynnis maculatus: 0 > 1
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Node 305: 0 > 01
Hoplocharax goethei: 01 > 1
Lonchogenys ilisha: 01 > 1
Heterocharax macrolepis: 01 > 0
Astyanax latens: 0 > 01
Hyphessobrycon igneus: 0 > 01
Hyphessobrycon bifasciatus: 0 > 01
Psellogrammus kennedyi: 0 > 01
Hyphessobrycon meridionalis: 0 > 01
Node 277: 0 > 1
Cheirodon stenodon: 0 > 1
Hemigrammus ocellifer: 0 > 1
Node 424: 0 > 1
Node 298: 0 > 1
Hyphessobrycon tortuguerae: 0 > 01
Carlana eigenmanni: 0 > 01
Node 387: 0 > 1
Node 417: 0 > 1
Hemigrammus tridens: 0 > 01
Hyphessobrycon heliacus: 0 > 01
Parecbasis cyclolepis: 1 > 0
Aphyocharacidium bolivianum: 1 > 01
Node 330: 0 > 1
Hemigrammus parana: 0 > 01
Hyphessobrycon moniliger: 0 > 01
Hemigrammus ulreyi: 1 > 01
Parapristella georgiae: 1 > 01

Hemigrammus erythrozonus: 0 > 1
Node 334: 0 > 01
Hyphessobrycon pulchripinnis: 1 > 01
Pristella maxillaris: 1 > 01
Serrapinnus calliurus: 1 > 0
Bryconamericus exodon: 1 > 01
Bryconamericus rubropictus: 01 > 1
Cheirodon aff. *troemneri*: 1 > 01
Hasemania hanseni: 0 > 1
Hyphessobrycon amandae: 0 > 01
Aulixidens eugeniae: 0 > 1
Piabina argentea: 0 > 1
Coptobrycon bilineatus: 0 > 01
Node 447: 0 > 01
Paracheirodon simulans: 01 > 1
Char. 230 (3 steps)
Root: 0
Node 248: 0 > 1
Node 242: 0 > 1
Node 391: 0 > 1
Char. 231 (10 steps)
Root: 1
Node 244: 1 > 0
Engraulisoma taeniatum: 0 > 1
Node 290: 0 > 01
Node 255: 0 > 1
Node 406: 0 > 1
Node 288: 01 > 1
Node 308: 01 > 1
Tetragonopterus argenteus: 01 > 0
Lonchogenys ilisha: 01 > 0
Heterocharax macrolepis: 01 > 1
Prionobrama paraguayensis: 1 > 0
Node 405: 1 > 0
Moenkhausia dichroura: 1 > 0
Char. 232 (3 steps)
Root: 0
Node 267: 0 > 01
Piaractus mesopotamicus: 01 > 1
Serrasalmus maculatus: 01 > 1
Metynnis maculatus: 01 > 0
Node 297: 0 > 1
Roeboides descalvadensis: 1 > 01
Cynopotamus argenteus: 1 > 01
Char. 233 (3 steps)
Root: 0
Piabucus melanostomus: 0 > 1
Hoplocharax goethei: 0 > 01
Node 297: 0 > 1
Acestrocephalus sardina: 1 > 0
Galeocharax humeralis: 1 > 01
Char. 234 (33 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Node 253: 1 > 01
Node 261: 01 > 0
Node 260: 01 > 0
Engraulisoma taeniatum: 01 > 1
Prochilodus lineatus: 1 > 0
Node 269: 0 > 1
Micralestes stormsi: 0 > 1
Node 255: 0 > 01
Node 289: 1 > 0
Agoniates anchovia: 01 > 1
Rhaphiodon vulpinus: 01 > 0
Acestrorhynchus pantaneiro: 01 > 1
Hyphessobrycon togoi: 0 > 1
Hyphessobrycon igneus: 0 > 01
Hyphessobrycon meridionalis: 0 > 1
Node 369: 0 > 1
Node 278: 0 > 1
Node 399: 1 > 0
Cheirodon stenodon: 0 > 1
Hemigrammus ocellifer: 0 > 1
Hyphessobrycon panamensis: 1 > 01
Nematocharax venustus: 0 > 01
Inpaichthys kerri: 1 > 0
Ectrepopterus uruguayensis: 1 > 0
Roeboexodon geryi: 0 > 1
Node 456: 1 > 0
Node 381: 1 > 01
Hyphessobrycon luetkenii: 1 > 01
Hemigrammus tridens: 01 > 0
Hasemania nana: 1 > 01
Astyanax taeniatus: 0 > 1
Node 448: 1 > 01
Node 393: 1 > 0
Hyphessobrycon compressus: 1 > 01
Hemigrammus unilineatus: 1 > 01
Hyphessobrycon rutiliflavidus: 1 > 01
Node 413: 01 > 1
Deuterodon langei: 01 > 0
Deuterodon singularis: 1 > 0
Node 361: 1 > 01
Node 415: 1 > 0
Hyphessobrycon socolofi: 1 > 0
Node 378: 01 > 0
Cheirodon interruptus: 1 > 0
Node 401: 1 > 0
Bario steindachneri: 01 > 0
Hyphessobrycon ecuadoriensis: 1 > 01
Hyphessobrycon eques: 1 > 0
Bryconella pallidifrons: 1 > 01
Node 425: 1 > 0
Char. 235 (14 steps)
Root: 0
Node 242: 0 > 1
Characidium borellii: 0 > 1
Iguanodectes geisleri: 0 > 1
Bryconops alburnoides: 0 > 1
Agoniates anchovia: 0 > 1
Prionobrama paraguayensis: 0 > 1
Cyanocharax alegretensis: 0 > 1
Attonitus ephimeros: 0 > 1
Node 414: 0 > 1
Moenkhausia sp. n.: 0 > 01
Parapristella georgiae: 0 > 01
Microschemobrycon melanotus: 0 > 01
Xenagoniates bondi: 0 > 1
Node 331: 0 > 1
Knodus moenkhausii: 0 > 01
Moenkhausia cf. *intermedia*: 0 > 1
Node 338: 0 > 1
Hyphessobrycon amandae: 0 > 01
Brittanichthys axelrodi: 0 > 1
Char. 236 (1 step)
Root: 0
Node 406: 0 > 1
Char. 237 (2 steps)
Root: 0
Node 406: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Char. 238 (6 steps)
Root: 0
Node 250: 0 > 1
Piabucus melanostomus: 0 > 1
Node 406: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Paragoniates alburnus: 0 > 1
Pseudocorynopoma doriae: 0 > 1
Char. 239 (3 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Engraulisoma taeniatum: 1 > 0
Node 289: 1 > 0
Char. 240 (1 step)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Char. 241 (2 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 376: 0 > 1
Char. 242 (2 steps)
Root: 1
Node 253: 1 > 0
Node 242: 1 > 0
Char. 243 (5 steps)
Root: 0
Node 259: 0 > 1
Node 290: 1 > 0
Iguanodectes geisleri: 1 > 01
Node 272: 1 > 0
Salminus brasiliensis: 1 > 0
Heterocharax macrolepis: 0 > 1
Char. 244 (8 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Leporinus striatus: 0 > 1
Node 275: 0 > 1
Aphyodite grammica: 0 > 1
Bryconexodon juruenae: 0 > 01
Hyphessobrycon herbertaxelrodi: 0 > 01
Bryconamericus agna: 0 > 01
Thayeria obliqua: 0 > 1
Roeboides descalvadensis: 0 > 01
Odontostilbe paraguayensis: 0 > 1
Xenagoniates bondi: 1 > 0
Diapoma terofali: 0 > 01
Nematobrycon palmeri: 0 > 01
Aulixidens eugeniae: 0 > 01
Creagrutus cf. *taphorni*: 0 > 1
Char. 245 (4 steps)
Root: 0
Node 249: 0 > 01
Node 248: 01 > 1
Node 252: 01 > 0
Hoplias cf. malabaricus: 01 > 1
Node 337: 0 > 1
Gymnocharacinus bergii: 0 > 1
Char. 246 (1 step)
Root: 0
Prionobrama paraguayensis: 0 > 1
Char. 247 (2 steps)
Root: 0
Puntius tetrazona: 0 > 01
Node 250: 0 > 1
Node 319: 0 > 1
Char. 248 (5 steps)
Root: 0
Puntius tetrazona: 0 > 01
Node 251: 0 > 1
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Node 406: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Paragoniates alburnus: 0 > 01
Aphyocharax anisitsi: 0 > 01
Xenagoniates bondi: 0 > 01
Pseudocorynopoma doriae: 0 > 1
Char. 249 (6 steps)
Root: 0
Node 251: 0 > 1
Pyrrhulina australis: 0 > 1
Piabucus melanostomus: 0 > 1
Node 406: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Paragoniates alburnus: 0 > 01
Xenagoniates bondi: 0 > 1
Char. 250 (10 steps)
Root: 1
Node 258: 1 > 01
Node 269: 01 > 0
Node 271: 01 > 0

Micralestes stormsi: 1 > 0
Salminus brasiliensis: 01 > 1
Node 289: 0 > 1
Agoniates anchovia: 01 > 1
Bryconaethiops macrops: 1 > 01
Alestes cf. *macrophthalmus*: 1 > 01
Acestrorhynchus pantaneiro: 01 > 0
Pseudochalceus kyburzi: 1 > 0
Node 323: 1 > 0
Node 275: 1 > 01
Hemibrycon dariensis: 1 > 01
Rhoadsia altipinna: 1 > 0
Node 274: 01 > 0
Node 375: 1 > 01
Gymnocharacinus bergii: 01 > 0
Char. 251 (3 steps)
Root: 0
Agoniates anchovia: 0 > 1
Node 274: 0 > 1
Gymnocharacinus bergii: 0 > 1
Char. 252 (12 steps)
Root: 1
Node 242: 1 > 0
Pyrrhulina australis: 1 > 0
Node 388: 1 > 0
Node 456: 1 > 0
Hyphessobrycon herbertaxelrodi: 1 > 01
Hemigrammus bleheri: 0 > 1
Knodus breviceps: 1 > 0
Node 331: 1 > 0
Hyphessobrycon negodagua: 1 > 01
Diapoma speculiferum: 1 > 0
Moenkhausia cf. *intermedia*: 1 > 0
Cheirodon aff. *troemneri*: 1 > 01
Aulixidens eugeniae: 1 > 0
Hyphessobrycon epicharis: 1 > 01
Creagrutus anary: 1 > 0
Paracheirodon axelrodi: 1 > 01
New Genus: 1 > 0
Char. 253 (15 steps)
Root: 0
Hoplias cf. *malabaricus*: 0 > 1
Node 267: 0 > 01
Prochilodus lineatus: 0 > 1
Piaractus mesopotamicus: 01 > 1
Node 257: 0 > 1
Serrasalmus maculatus: 01 > 1
Metynnis maculatus: 01 > 0
Piabucus melanostomus: 0 > 01
Brycon pesu: 1 > 0
Node 336: 0 > 1
Astyanax mexicanus: 0 > 01
Oligosarcus argenteus: 1 > 0
Astyanax goyanensis: 0 > 1
Hyphessobrycon bifasciatus: 0 > 01
Astyanax troya: 0 > 01
Markiana nigripinnis: 0 > 1
Node 391: 0 > 1
Probolodus heterostomus: 0 > 1
Hasemania kalunga: 0 > 01
Hyphessobrycon panamensis: 0 > 01
Node 310: 0 > 1
Node 297: 0 > 1
Node 455: 0 > 1
Hyphessobrycon moniliger: 0 > 01
Hyphessobrycon micropterus: 0 > 01
Nantis cf. *indefessus*: 0 > 01
Nantis indefessus: 0 > 01
Hyphessobrycon eques: 0 > 01
Hyphessobrycon megalopterus: 0 > 01
Hyphessobrycon bentosi: 0 > 01
Char. 254 (4 steps)
Root: 0
Node 290: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Markiana nigripinnis: 1 > 0
Hasemania kalunga: 1 > 01
Hemigrammus tocantinsi: 1 > 01
Hemigrammus ocellifer: 1 > 01
Node 275: 1 > 0
Hemigrammus parana: 1 > 01
Knodus moenkhausii: 1 > 01
Cheirodon aff. *troemneri*: 1 > 01
Cheirodon troemneri: 1 > 01
Bryconella pallidifrons: 1 > 01
Hyphessobrycon axelrodi: 1 > 01
Char. 255 (1 step)
Root: 0
Node 251: 0 > 1
Char. 256 (1 step)
Root: 0
Hollandichthys multifasciatus: 0 > 1
Mimagoniates rheocharis: 0 > 01
Char. 257 (2 steps)
Root: 0
Node 314: 0 > 1
Node 317: 1 > 0
Char. 258 (25 steps)
Root: 1
Node 252: 1 > 01
Node 251: 01 > 0
Node 259: 01 > 1
Node 267: 01 > 0
Node 255: 1 > 01
Node 406: 1 > 0
Agoniates anchovia: 01 > 0
Hoplocharax goethei: 1 > 0
Rhaphiodon vulpinus: 01 > 0
Acestrorhynchus pantaneiro: 01 > 1
Node 308: 1 > 0
Node 437: 1 > 0
Hollandichthys multifasciatus: 1 > 0
Hasemania kalunga: 1 > 0
Node 276: 1 > 0
Cyanocharax alburnus: 1 > 0
Node 321: 1 > 01
Node 387: 1 > 0
Aphyocharax nattereri: 0 > 01
Cyanocharax alegretensis: 01 > 0
Axelrodia lindeae: 1 > 0
Paragoniates alburnus: 0 > 1
Aphyocharax dentatus: 0 > 1
Node 319: 01 > 0
Acrobrycon tarijae: 01 > 1
Hyphessobrycon rutiliflavidus: 1 > 0
Hemigrammus erythrozonus: 1 > 01
Hyphessobrycon parvellus: 1 > 0
Cheirodon interruptus: 1 > 0
Cheirodon troemneri: 1 > 0
Node 376: 1 > 0
Node 447: 1 > 01
Paracheirodon simulans: 01 > 0
Node 425: 1 > 0
Char. 259 (4 steps)
Root: 1
Node 253: 1 > 0
Node 242: 1 > 0
Leporinus striatus: 1 > 01
Node 265: 0 > 01
Chalceus macrolepidotus: 01 > 1
Micralestes stormsi: 01 > 0
Node 263: 01 > 1
Astyanax paris: 0 > 01
Char. 260 (2 steps)
Root: 1
Node 244: 1 > 0
Bryconaethiops macrops: 0 > 1
Char. 261 (3 steps)
Root: 0
Engraulisoma taeniatum: 0 > 1
Node 406: 0 > 1
Agoniates anchovia: 0 > 1
Char. 262 (6 steps)
Root: 0
Node 251: 0 > 1
Hoplias cf. *malabaricus*: 0 > 1
Piabucus melanostomus: 0 > 1
Node 406: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Stethaprion erythrops: 0 > 1
Char. 263 (1 step)
Root: 0
Node 394: 0 > 1
Hyphessobrycon socolofi: 0 > 01
Char. 264 (2 steps)
Root: 0
Node 252: 0 > 1
Node 264: 1 > 0
Char. 265 (13 steps)
Root: 0
Node 253: 0 > 01
Node 251: 01 > 1
Pyrrhulina australis: 01 > 1
Hoplias cf. *malabaricus*: 01 > 0
Node 258: 01 > 1
Node 265: 01 > 0
Node 266: 01 > 0
Piaractus mesopotamicus: 01 > 1
Node 374: 1 > 0
Bryconops affinis: 0 > 01
Node 308: 1 > 01
Node 307: 01 > 0
Stichonodon insignis: 01 > 0
Gymnocorymbus ternetzi: 01 > 1
Moenkhausia hemigrammoides: 1 > 0
Exodon paradoxus: 1 > 0
Hemigrammus tridens: 1 > 01
Parecbasis cyclolepis: 1 > 0
Parapristella georgiae: 1 > 01
Hemigrammus bleheri: 1 > 01
Moenkhausia xinguensis: 1 > 0
Cheirodon troemneri: 1 > 01
Creagrutus anary: 1 > 0
Brittanichthys axelrodi: 1 > 0
Char. 266 (22 steps)
Root: 1
Node 253: 1 > 0
Hemiodus cf. *thayeria*: 1 > 0
Metynnis maculatus: 0 > 1
Node 270: 0 > 01
Salminus brasiliensis: 0 > 1
Node 289: 0 > 1
Brycon falcatus: 01 > 1
Brycon orbignyanus: 0 > 1
Astyanax paris: 1 > 01
Oligosarcus cf. *jenynsii*: 1 > 01
Hyphessobrycon meridionalis: 1 > 01
Hyphessobrycon griemi: 1 > 01
Markiana nigripinnis: 1 > 01
Node 278: 1 > 0
Node 299: 1 > 01
Hollandichthys multifasciatus: 1 > 01
Cheirodon stenodon: 1 > 0
Node 298: 01 > 0
Node 314: 0 > 1
Inpaichthys kerri: 0 > 01
Carlana eigenmanni: 1 > 01
Roeboexodon geryi: 01 > 0
Node 371: 01 > 1
Aphyodite grammica: 0 > 01
Node 455: 1 > 01
Hyphessobrycon herbertaxelrodi: 1 > 01
Hyphessobrycon elachys: 1 > 0
Node 306: 0 > 01
Parecbasis cyclolepis: 0 > 01

Astyanax intermedius: 01 > 0
Node 448: 1 > 0
Cheirodon jaguaribensis: 1 > 01
Hyphessobrycon moniliger: 1 > 01
Parapristella georgiae: 1 > 01
Thayeria obliqua: 1 > 0
Roeboides microlepis: 01 > 1
Hyphessobrycon micropterus: 1 > 01
Bario steindachneri: 1 > 0
Moenkhausia cf. *intermedia*: 1 > 01
Cheirodon troemneri: 1 > 01
Hasemania hanseni: 1 > 01
Hyphessobrycon rosaceus: 1 > 01
Hyphessobrycon megalopterus: 1 > 01
Node 410: 1 > 0
Nematobrycon palmeri: 1 > 0
Hyphessobrycon sweglesi: 1 > 01
Paracheirodon simulans: 0 > 1
Hyphessobrycon axelrodi: 0 > 1
Char. 267 (1 step)
Root: 0
Node 307: 0 > 1
Char. 268 (6 steps)
Root: 0
Node 311: 0 > 1
Pseudochalceus kyburzi: 0 > 1
Hyphessobrycon loweae: 0 > 1
Hyphessobrycon elachys: 0 > 1
Pseudocorynopoma doriae: 0 > 1
Node 434: 0 > 1
Hyphessobrycon rosaceus: 0 > 01
Hyphessobrycon megalopterus: 0 > 01
Hyphessobrycon bentosi: 0 > 01
Hyphessobrycon hasemani: 0 > 01
Hyphessobrycon sweglesi: 1 > 01
Char. 269 (2 steps)
Root: 0
Node 313: 0 > 1
Node 317: 1 > 0
Char. 270 (11 steps)
Root: 1
Node 251: 1 > 01
Engraulisoma taeniatum: 01 > 0
Thoracocharax stellatus: 01 > 1
Carnegiella strigata: 01 > 0
Piabucus melanostomus: 1 > 0
Hoplocharax goethei: 1 > 0
Node 418: 1 > 0
Node 324: 1 > 0
Node 275: 1 > 01
Prionobrama paraguayensis: 01 > 0
Aphyocharax nattereri: 01 > 0
Node 273: 01 > 1
Node 294: 01 > 0
Paragoniates alburnus: 01 > 1
Node 318: 0 > 1
Aulixidens eugeniae: 0 > 01
Coptobrycon bilineatus: 1 > 0
Char. 271 (5 steps)
Root: 0
Node 243: 0 > 1
Pyrrhulina australis: 0 > 1
Node 259: 0 > 1
Engraulisoma taeniatum: 0 > 1
Mimagoniates rheocharis: 1 > 0
Char. 272 (8 steps)
Root: 1
Node 249: 1 > 0
Node 260: 0 > 01
Node 258: 01 > 0
Node 265: 01 > 1
Piaractus mesopotamicus: 01 > 1
Serrasalmus maculatus: 01 > 1
Metynnis maculatus: 01 > 0
Rhaphiodon vulpinus: 0 > 1
Astyanax janeiroensis: 0 > 1
Node 457: 0 > 1
Node 454: 0 > 1
Char. 273 (2 steps)
Root: 0
Node 250: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Char. 274 (7 steps)
Root: 0
Distichodus maculatus: 0 > 1
Node 250: 0 > 1
Node 265: 0 > 01
Chalceus macrolepidotus: 01 > 1
Micralestes stormsi: 01 > 1
Node 263: 01 > 0
Piabucus melanostomus: 0 > 1
Node 255: 0 > 1
Node 406: 0 > 1
Char. 275 (1 step)
Root: 0
Node 266: 0 > 1
Char. 276 (11 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Node 251: 1 > 01
Engraulisoma taeniatum: 01 > 0
Thoracocharax stellatus: 01 > 1
Carnegiella strigata: 01 > 0
Node 264: 1 > 0
Piabucus melanostomus: 1 > 0
Hoplocharax goethei: 1 > 0
Node 418: 1 > 0
Node 324: 1 > 0
Node 293: 1 > 01
Prionobrama paraguayensis: 01 > 0
Node 294: 01 > 0
Paragoniates alburnus: 01 > 1
Hyphessobrycon moniliger: 1 > 01
Mimagoniates rheocharis: 0 > 1
Char. 277 (10 steps)
Root: 01
Puntius tetrazona: 01 > 0
Distichodus maculatus: 01 > 1
Node 242: 01 > 1
Characidium rachovii: 01 > 1
Characidium borellii: 01 > 0
Hemiodus cf. *thayeria*: 01 > 0
Node 246: 01 > 1
Pyrrhulina australis: 01 > 0
Hoplias cf. *malabaricus*: 01 > 1
Node 267: 01 > 1
Engraulisoma taeniatum: 01 > 0
Node 258: 01 > 0
Thoracocharax stellatus: 01 > 1
Carnegiella strigata: 01 > 0
Node 264: 01 > 0
Chalceus macrolepidotus: 01 > 1
Stichonodon insignis: 0 > 1
Stethaprion erythrops: 0 > 1
Inpaichthys kerri: 0 > 01
Char. 278 (5 steps)
Root: 0
Distichodus maculatus: 0 > 1
Characidium rachovii: 0 > 1
Hoplias cf. *malabaricus*: 0 > 1
Node 267: 0 > 1
Thoracocharax stellatus: 0 > 1
Char. 279 (6 steps)
Root: 1
Node 249: 1 > 0
Parodon nasus: 1 > 01
Apareiodon affinis: 1 > 01
Node 260: 0 > 1
Leporinus striatus: 1 > 0
Prochilodus lineatus: 1 > 01
Node 268: 1 > 0
Micralestes stormsi: 1 > 0
Node 289: 1 > 0
Acestrorhynchus pantaneiro: 1 > 01
Char. 280 (18 steps)
Root: 1
Puntius tetrazona: 1 > 01
Bryconaethiops macrops: 1 > 0
Node 309: 1 > 0
Bramocharax bransfordii: 1 > 0
Node 352: 1 > 0
Astyanax mexicanus: 1 > 01
Astyanax puka: 1 > 01
Hyphessobrycon igneus: 1 > 01
Hyphessobrycon bifasciatus: 1 > 01
Astyanax janeiroensis: 1 > 0
Astyanax troya: 1 > 01
Markiana nigripinnis: 0 > 01
Node 385: 1 > 0
Astyanax asuncionensis: 0 > 01
Astyanax cf. *abramis*: 0 > 01
Astyanax lineatus: 0 > 01
Astyanax cf. *asuncionensis*: 0 > 01
Hyphessobrycon langeanii: 1 > 01
Hemigrammus tocantinsi: 1 > 01
Hemigrammus ocellifer: 1 > 01
Moenkhausia sanctaefilomenae: 1 > 01
Moenkhausia forestii: 1 > 01
Nematocharax venustus: 1 > 01
Node 365: 1 > 0
Hyphessobrycon tortuguerae: 0 > 1
Node 297: 1 > 0
Node 345: 1 > 0
Bryconamericus mennii: 1 > 01
Exodon paradoxus: 1 > 01
Cyanocharax alegretensis: 1 > 01
Hyphessobrycon elachys: 0 > 01
Hasemania nana: 0 > 01
Node 316: 1 > 01
Cheirodon jaguaribensis: 0 > 01
Hyphessobrycon compressus: 0 > 01
Hemigrammus unilineatus: 0 > 1
Hyphessobrycon rutiliflavidus: 0 > 01
Node 379: 0 > 1
Microschemobrycon melanotus: 0 > 1
Odontostilbe paraguayensis: 01 > 0
Bryconamericus alpha: 1 > 01
Deuterodon iguape: 1 > 01
Cheirodon interruptus: 01 > 1
Serrapinnus calliurus: 01 > 0
Diapoma terofali: 1 > 01
Bario steindachneri: 0 > 1
Moenkhausia dichroura: 0 > 01
Cheirodon aff. *troemneri*: 0 > 01
Hyphessobrycon ecuadoriensis: 0 > 1
Hyphessobrycon megalopterus: 0 > 01
Paracheirodon axelrodi: 0 > 01
Paracheirodon simulans: 0 > 1
Char. 281 (12 steps)
Root: 01
Node 244: 01 > 0
Distichodus maculatus: 01 > 1
Hemiodus cf. *thayeria*: 0 > 1
Parodon nasus: 0 > 01
Pyrrhulina australis: 0 > 1
Node 259: 0 > 01
Node 250: 0 > 1
Piaractus mesopotamicus: 0 > 01
Node 257: 01 > 1
Node 264: 01 > 0
Chalceus macrolepidotus: 01 > 1
Node 268: 01 > 1
Node 290: 01 > 0
Bryconops alburnoides: 01 > 1

Node 373: 01 > 0
Node 292: 0 > 1
Node 320: 0 > 01
Acrobrycon tarijae: 01 > 1
Node 318: 01 > 1
Node 325: 01 > 0
Node 375: 0 > 1
Char. 282 (24 steps)
Root: 1
Node 249: 1 > 0
Hemiodus cf. *thayeria*: 1 > 0
Node 267: 0 > 1
Micralestes stormsi: 0 > 1
Node 290: 0 > 01
Piabucus melanostomus: 0 > 01
Node 289: 01 > 1
Agoniates anchovia: 0 > 01
Node 304: 01 > 1
Hoplocharax goethei: 01 > 0
Triportheus pantanensis: 0 > 01
Triportheus nematurus: 0 > 01
Node 402: 1 > 0
Node 279: 1 > 0
Hyphessobrycon griemi: 1 > 0
Node 384: 1 > 0
Moenkhausia pittieri: 1 > 01
Pseudochalceus kyburzi: 1 > 01
Hyphessobrycon langeanii: 0 > 01
Moenkhausia forestii: 1 > 0
Node 372: 1 > 01
Ectrepopterus uruguayensis: 1 > 01
Hyphessobrycon tortuguerae: 1 > 01
Roeboexodon geryi: 01 > 0
Prodontocharax melanotus: 0 > 1
Exodon paradoxus: 01 > 1
Bryconexodon juruenae: 01 > 0
Node 421: 0 > 1
Hyphessobrycon herbertaxelrodi: 0 > 01
Hyphessobrycon loweae: 0 > 1
Parecbasis cyclolepis: 0 > 1
Node 316: 0 > 01
Hemigrammus parana: 1 > 01
Cheirodon jaguaribensis: 1 > 01
Node 416: 1 > 0
Hyphessobrycon compressus: 0 > 01
Hyphessobrycon rutiliflavidus: 0 > 01
Acestrocephalus sardina: 1 > 0
Odontostilbe paraguayensis: 01 > 1
Hyphessobrycon pulchripinnis: 1 > 01
Hyphessobrycon micropterus: 0 > 01
Cynopotamus argenteus: 1 > 01
Cheirodon interruptus: 01 > 0
Serrapinnus calliurus: 01 > 1
Bario steindachneri: 1 > 0
Moenkhausia cf. *intermedia*: 1 > 01
Jupiaba mucronata: 1 > 01
Hyphessobrycon bentosi: 0 > 01
Node 337: 0 > 01
Hyphessobrycon sweglesi: 0 > 01
Hyphessobrycon epicharis: 0 > 01
Hyphessobrycon pyrrhonotus: 0 > 1
Creagrutus anary: 01 > 1
Char. 283 (6 steps)
Root: 0
Engraulisoma taeniatum: 0 > 1
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Node 254: 0 > 1
Xenagoniates bondi: 0 > 1
Node 325: 0 > 1
Gymnocharacinus bergii: 0 > 1
Char. 284 (7 steps)
Root: 0
Node 250: 0 > 1
Piabucus melanostomus: 0 > 1
Node 255: 0 > 01
Agoniates anchovia: 01 > 1
Rhaphiodon vulpinus: 01 > 1
Acestrorhynchus pantaneiro: 01 > 0
Node 298: 0 > 1
Node 293: 0 > 1
Node 319: 0 > 1
Char. 285 (8 steps)
Root: 0
Distichodus maculatus: 0 > 1
Node 260: 0 > 01
Node 267: 01 > 1
Node 258: 01 > 1
Node 265: 01 > 0
Iguanodectes geisleri: 1 > 0
Cheirodon stenodon: 1 > 01
Hemigrammus ocellifer: 1 > 01
Aphyocharacidium bolivianum: 1 > 01
Cheirodon aff. *troemneri*: 1 > 0
Hyphessobrycon bentosi: 1 > 01
Node 337: 1 > 0
Hyphessobrycon minor: 1 > 01
Node 446: 1 > 0
Coptobrycon bilineatus: 1 > 0
Bryconella pallidifrons: 1 > 01
Paracheirodon innesi: 0 > 01
New Genus: 1 > 01
Char. 286 (2 steps)
Root: 0
Node 252: 0 > 1
Chalceus macrolepidotus: 1 > 0
Nantis cf. *indefessus*: 1 > 01
Nantis indefessus: 1 > 01
Creagrutus cf. *taphorni*: 1 > 01
Creagrutus anary: 1 > 01
Char. 287 (18 steps)
Root: 0
Node 252: 0 > 1
Node 265: 1 > 0
Node 262: 0 > 1
Node 407: 1 > 0
Node 419: 1 > 01
Node 418: 01 > 0
Hemigrammus tocantinsi: 01 > 0
Hemigrammus ocellifer: 01 > 1
Hyphessobrycon cachimbensis: 1 > 01
Node 388: 1 > 0
Prodontocharax melanotus: 1 > 0
Node 326: 1 > 0
Bryconamericus iheringii: 1 > 01
Node 443: 1 > 01
Hemigrammus tridens: 1 > 01
Hyphessobrycon elachys: 0 > 01
Aphyocharax anisitsi: 1 > 01
Node 342: 1 > 01
Astyanax jenynsii: 1 > 0
Parapristella georgiae: 01 > 0
Node 379: 1 > 01
Hemigrammus erythrozonus: 0 > 01
Microschemobrycon casiquiare: 1 > 01
Bryconamericus thomasi: 0 > 01
Bryconamericus cf. *iheringii*: 0 > 01
Hyphessobrycon negodagua: 01 > 0
Cheirodon interruptus: 1 > 01
Knodus meridae: 01 > 0
Cheirodon troemneri: 1 > 0
Node 343: 0 > 01
Node 410: 1 > 01
Node 376: 01 > 0
Nematobrycon palmeri: 01 > 1
Aulixidens eugeniae: 01 > 1
Piabina argentea: 0 > 01
Node 409: 01 > 0
Hyphessobrycon axelrodi: 0 > 1
Char. 288 (22 steps)
Root: 0
Node 250: 0 > 01
Node 258: 0 > 1
Node 266: 0 > 1
Thoracocharax stellatus: 01 > 1
Iguanodectes geisleri: 1 > 0
Node 270: 1 > 0
Salminus brasiliensis: 1 > 01
Brycon orbignyanus: 1 > 01
Hoplocharax goethei: 1 > 01
Bryconops affinis: 1 > 01
Acestrorhynchus pantaneiro: 1 > 0
Node 286: 1 > 0
Node 404: 1 > 0
Hyphessobrycon anisitsi: 0 > 01
Node 352: 0 > 1
Oligosarcus argenteus: 0 > 01
Astyanax cf. *rutilus*: 0 > 1
Oligosarcus cf. *jenynsii*: 0 > 01
Node 430: 0 > 1
Astyanax puka: 0 > 01
Hyphessobrycon meridionalis: 0 > 1
Node 301: 0 > 1
Astyanax altiparanae: 1 > 01
Astyanax lineatus: 1 > 01
Astyanax cf. *asuncionensis*: 1 > 01
Probolodus heterostomus: 0 > 1
Moenkhausia pittieri: 0 > 01
Node 341: 0 > 1
Nematocharax venustus: 1 > 01
Node 372: 1 > 0
Ectrepopterus uruguayensis: 0 > 01
Hyphessobrycon tortuguerae: 0 > 01
Node 293: 0 > 1
Node 321: 0 > 1
Node 417: 0 > 1
Axelrodia lindeae: 0 > 01
Acrobrycon tarijae: 1 > 01
Moenkhausia sp. n.: 0 > 01
Hyphessobrycon moniliger: 0 > 01
Hyphessobrycon compressus: 0 > 01
Hemigrammus unilineatus: 0 > 01
Microschemobrycon melanotus: 0 > 01
Bryconamericus alpha: 0 > 01
Jupiaba polylepis: 0 > 01
Hyphessobrycon takasei: 1 > 01
Hyphessobrycon pulchripinnis: 1 > 01
Moenkhausia dichroura: 0 > 01
Jupiaba mucronata: 0 > 01
Cheirodon troemneri: 1 > 01
Hyphessobrycon copelandi: 0 > 01
Node 434: 0 > 01
Hyphessobrycon eques: 0 > 01
Hyphessobrycon werneri: 0 > 01
Hyphessobrycon bentosi: 0 > 01
Node 436: 01 > 1
Nematobrycon palmeri: 0 > 1
Hyphessobrycon hasemani: 0 > 1
Char. 289 (11 steps)
Root: 0
Thoracocharax stellatus: 0 > 1
Metynnis maculatus: 0 > 1
Piabucus melanostomus: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Tetragonopterus argenteus: 0 > 01
Lonchogenys ilisha: 0 > 01
Heterocharax macrolepis: 0 > 01
Gymnocorymbus ternetzi: 0 > 1
Stethaprion erythrops: 0 > 1
Node 351: 0 > 1
Node 348: 1 > 0
Node 298: 0 > 1
Node 292: 0 > 1
Acestrocephalus sardina: 1 > 01
Pseudocorynopoma doriae: 0 > 1

Char. 290 (3 steps)
Root: 0
Nematocharax venustus: 0 > 01
Node 344: 0 > 01
Axelrodia lindeae: 01 > 1
Parapristella georgiae: 0 > 01
Serrapinnus calliurus: 0 > 1
Node 409: 0 > 1
Hyphessobrycon axelrodi: 1 > 01
Char. 291 (1 step)
Root: 0
Hasemania nana: 0 > 1
Char. 292 (2 steps)
Root: 0
Node 242: 0 > 1
Markiana nigripinnis: 0 > 1
Char. 293 (5 steps)
Root: 0
Node 268: 0 > 1
Gymnocorymbus ternetzi: 0 > 1
Node 297: 0 > 01
Charax stenopterus: 01 > 1
Node 306: 01 > 1
Acestrocephalus sardina: 01 > 0
Galeocharax humeralis: 01 > 0
Cynopotamus argenteus: 01 > 1
Char. 294 (9 steps)
Root: 0
Node 249: 0 > 2
Node 259: 2 > 0
Engraulisoma taeniatum: 2 > 0
Node 264: 0 > 1
Node 309: 0 > 1
Psellogrammus kennedyi: 0 > 1
Markiana nigripinnis: 0 > 01
Node 293: 0 > 1
Node 306: 0 > 1
Hyphessobrycon socolofi: 0 > 01
Pseudocorynopoma doriae: 0 > 1
Hyphessobrycon eques: 0 > 01
Char. 295 (2 steps)
Root: 1
Node 252: 1 > 0
Node 265: 0 > 1 C
Char. 296 (6 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Node 253: 1 > 01
Node 261: 01 > 0
Node 260: 01 > 1
Engraulisoma taeniatum: 01 > 0
Thoracocharax stellatus: 01 > 0
Carnegiella strigata: 01 > 1
Agoniates anchovia: 1 > 0
Acestrorhynchus pantaneiro: 1 > 01
Gymnocorymbus ternetzi: 1 > 01
Hemigrammus ocellifer: 1 > 01
Prionobrama paraguayensis: 1 > 0
Parecbasis cyclolepis: 1 > 01
Hemigrammus unilineatus: 1 > 01
Pristella maxillaris: 1 > 01
Hyphessobrycon eques: 1 > 01
Piabina argentea: 1 > 01
Char. 297 (3 steps)
Root: 0
Node 247: 0 > 1
Node 265: 0 > 1
Brycon meeki: 0 > 1
Hyphessobrycon igneus: 0 > 01
Hasemania kalunga: 0 > 01
Char. 298 (6 steps)
Root: 1
Distichodus maculatus: 1 > 0
Hemiodus cf. *thayeria*: 1 > 0
Hoplias cf. *malabaricus*: 1 > 0
Node 267: 1 > 0
Node 264: 1 > 0
Node 254: 1 > 0
Heterocharax macrolepis: 1 > 01
Char. 299 (3 steps)
Root: 0
Distichodus maculatus: 0 > 1
Hemiodus cf. *thayeria*: 0 > 1
Serrasalmus maculatus: 0 > 1
Brittanichthys axelrodi: 0 > 01
Char. 300 (4 steps)
Root: 01
Node 241: 01 > 1
Puntius tetrazona: 01 > 0
Node 261: 1 > 0
Engraulisoma taeniatum: 1 > 0
Node 265: 1 > 0
Carnegiella strigata: 1 > 01
Char. 301 (2 steps)
Root: 0
Axelrodia lindeae: 0 > 1
Node 317: 0 > 1
Char. 302 (5 steps)
Root: 0
Salminus brasiliensis: 0 > 1
Node 373: 0 > 1
Acestrorhynchus pantaneiro: 0 > 01
Tetragonopterus argenteus: 0 > 01
Node 295: 0 > 01
Axelrodia lindeae: 0 > 01
Aphyocharacidium bolivianum: 0 > 01
Roeboides microlepis: 0 > 01
Node 303: 01 > 1
Node 317: 0 > 1
Bryconamericus thomasi: 0 > 01
Moenkhausia dichroura: 0 > 01
Node 337: 0 > 1
Gymnocharacinus bergii: 0 > 01
Char. 303 (3 steps)
Root: 0
Hoplocharax goethei: 0 > 1
Axelrodia lindeae: 0 > 1
Node 317: 0 > 1
Char. 304 (1 step)
Root: 0
Node 264: 0 > 1
Char. 305 (1 step)
Root: 0
Node 258: 0 > 1
Pristella maxillaris: 1 > 01
Char. 306 (15 steps)
Root: 0
Node 243: 0 > 1
Node 260: 0 > 1
Node 305: 1 > 0
Node 287: 1 > 0
Bramocharax bransfordii: 1 > 0
Gymnocorymbus ternetzi: 1 > 0
Oligosarcus argenteus: 1 > 0
Markiana nigripinnis: 0 > 1
Probolodus heterostomus: 0 > 1
Cheirodon stenodon: 0 > 01
Moenkhausia sanctaefilomenae: 0 > 01
Moenkhausia forestii: 0 > 01
Carlana eigenmanni: 0 > 01
Node 371: 0 > 1
Node 296: 0 > 01
Bryconamericus iheringii: 0 > 1
Node 362: 0 > 1
Roeboides microlepis: 01 > 1
Galeocharax humeralis: 01 > 1
Cynopotamus argenteus: 01 > 0
Bryconamericus exodon: 0 > 01
Moenkhausia cf. *intermedia*: 1 > 01
Jupiaba mucronata: 0 > 1
Cheirodon aff. *troemneri*: 0 > 01
Odontostoechus lethostigmus: 0 > 01
Coptobrycon bilineatus: 0 > 01
Char. 307 (31 steps)
Root: 0
Characidium borellii: 0 > 1
Node 251: 0 > 01
Node 250: 01 > 1
Node 258: 0 > 01
Node 269: 01 > 1
Node 270: 01 > 1
Salminus brasiliensis: 01 > 1
Node 406: 01 > 0
Node 254: 01 > 0
Astyanax paris: 1 > 0
Hyphessobrycon togoi: 1 > 0
Hyphessobrycon griemi: 1 > 0
Markiana nigripinnis: 1 > 0
Pseudochalceus kyburzi: 1 > 0
Hyphessobrycon langeanii: 1 > 0
Node 383: 1 > 0
Inpaichthys kerri: 1 > 0
Node 451: 1 > 0
Node 365: 1 > 0
Rhoadsia altipinna: 1 > 0
Bryconamericus mennii: 1 > 0
Exodon paradoxus: 1 > 0
Node 397: 1 > 01
Node 292: 1 > 0
Hyphessobrycon herbertaxelrodi: 1 > 0
Hemigrammus tridens: 0 > 1
Node 389: 0 > 1
Microschemobrycon melanotus: 01 > 0
Hyphessobrycon socolofi: 0 > 1
Node 427: 1 > 0
Bario steindachneri: 0 > 1
Cheirodon aff. *troemneri*: 0 > 1
Hasemania hanseni: 0 > 1
Node 410: 0 > 01
Hyphessobrycon erythrostigma: 0 > 1
Node 409: 01 > 1
Node 447: 01 > 0
Paracheirodon axelrodi: 01 > 1
Char. 308 (4 steps)
Root: 01
Node 252: 01 > 1
Characidium borellii: 01 > 0
Mimagoniates rheocharis: 1 > 0
Node 401: 1 > 01
Nantis indefessus: 01 > 0
Node 446: 1 > 01
Paracheirodon axelrodi: 01 > 0
Char. 309 (19 steps)
Root: 01
Characidium borellii: 01 > 1
Node 250: 01 > 0
Node 291: 01 > 1
Piabucus melanostomus: 01 > 0
Salminus brasiliensis: 01 > 1
Brycon pesu: 01 > 0
Stethaprion erythrops: 1 > 0
Astyanax goyanensis: 1 > 0
Node 430: 1 > 0
Psellogrammus kennedyi: 1 > 0
Node 441: 1 > 0
Node 399: 1 > 01
Hemigrammus ocellifer: 1 > 0
Moenkhausia forestii: 01 > 0
Phenacogaster tegatus: 1 > 0
Node 306: 1 > 01
Astyanax giton: 1 > 0
Hyphessobrycon compressus: 1 > 0
Hemigrammus bleheri: 1 > 0
Roeboides microlepis: 01 > 0

Knodus meridae: 1 > 0
Pseudocorynopoma doriae: 1 > 0
Creagrutus anary: 1 > 0
Brittanichthys axelrodi: 1 > 0
Char. 310 (7 steps)
Root: 0
Node 355: 0 > 1
Node 354: 0 > 1
Astyanax cf. *abramis*: 0 > 01
Node 367: 0 > 1
Phenacogaster tegatus: 0 > 1
Astyanax giton: 1 > 0
Bryconamericus cf. *iheringii*: 0 > 1
Bryconamericus rubropictus: 0 > 1
Char. 311 (10 steps)
Root: 0
Node 308: 0 > 01
Poptella paraguayensis: 01 > 1
Hyphessobrycon igneus: 0 > 1
Node 355: 0 > 1
Node 354: 0 > 1
Node 368: 0 > 1
Astyanax cf. *abramis*: 0 > 01
Nematocharax venustus: 0 > 1
Node 332: 0 > 1
Hemigrammus erythrozonus: 0 > 1
Node 427: 0 > 01
Bryconamericus rubropictus: 0 > 1
Hyphessobrycon erythrostigma: 01 > 1
Char. 311 (10 steps)
Root: 0
Node 308: 0 > 01
Poptella paraguayensis: 01 > 1
Hyphessobrycon igneus: 0 > 1
Node 355: 0 > 1
Node 354: 0 > 1
Node 368: 0 > 1
Astyanax cf. *abramis*: 0 > 01
Nematocharax venustus: 0 > 1
Node 332: 0 > 1
Hemigrammus erythrozonus: 0 > 1
Node 427: 0 > 01
Bryconamericus rubropictus: 0 > 1
Hyphessobrycon erythrostigma: 01 >
Char. 313 (9 steps)
Root: 0
Node 402: 0 > 01
Oligosarcus bolivianus: 01 > 1
Node 391: 0 > 01
Hollandichthys multifasciatus: 01 > 1
Node 346: 0 > 01
Node 322: 0 > 1
Prodontocharax melanotus: 0 > 01
Node 293: 0 > 01
Node 344: 01 > 1
Prionobrama paraguayensis: 01 > 1
Aphyocharax anisitsi: 0 > 1
Hemigrammus erythrozonus: 0 > 01
Node 317: 0 > 1
Knodus breviceps: 0 > 01
Bryconamericus alpha: 0 > 01
Knodus moenkhausii: 0 > 1
Bryconamericus cf. *exodon*: 0 > 1
Char. 314 (9 steps)
Root: 0
Node 402: 0 > 1
Astyanax abramis: 0 > 1
Astyanax cf. *asuncionensis*: 0 > 1
Cheirodon stenodon: 0 > 1
Node 322: 0 > 1
Node 365: 0 > 1
Node 313: 0 > 1
Axelrodia lindeae: 0 > 1
Knodus moenkhausii: 0 > 1
Odontostoechus lethostigmus: 1 > 01
Char. 315 (14 steps)
Root: 0
Astyanax mexicanus: 0 > 1
Cheirodon stenodon: 0 > 1
Node 365: 0 > 1
Aphyocharacidium bolivianum: 0 > 1
Aphyocharax anisitsi: 0 > 1
Hemigrammus ulreyi: 0 > 1
Parapristella georgiae: 0 > 1
Node 379: 0 > 01
Hemigrammus erythrozonus: 0 > 1
Pristella maxillaris: 0 > 1
Cheirodon interruptus: 0 > 1
Hasemania hanseni: 01 > 1
Nantis indefessus: 0 > 1
Node 343: 0 > 01
Aulixidens eugeniae: 01 > 1
Node 425: 0 > 1
Char. 316 (3 steps)
Root: 0
Node 308: 0 > 02
Node 307: 02 > 2
Node 365: 0 > 2
Serrapinnus calliurus: 0 > 1
Hyphessobrycon eques: 0 > 02
Char. 317 (3 steps)
Root: 0
Distichodus maculatus: 0 > 1
Psellogrammus kennedyi: 0 > 3
Node 295: 0 > 2
Hyphessobrycon socolofi: 0 > 01
Char. 318 (2 steps)
Root: 0
Tetragonopterus argenteus: 0 > 1
Markiana nigripinnis: 0 > 1
Bario steindachneri: 0 > 01
Char. 319 (10 steps)
Root: 0
Puntius tetrazona: 0 > 01
Node 248: 0 > 1
Node 251: 0 > 1
Node 291: 0 > 1
Node 406: 0 > 1
Agoniates anchovia: 0 > 1
Node 351: 1 > 0
Markiana nigripinnis: 0 > 1
Exodon paradoxus: 1 > 0
Roeboides microlepis: 1 > 0
Phenagoniates macrolepis: 1 > 0
Char. 320 (18 steps)
Root: 1
Distichodus maculatus: 1 > 0
Node 267: 1 > 0
Cyphocharax spilotus: 1 > 0
Node 268: 1 > 0
Node 254: 1 > 0
Hyphessobrycon griemi: 1 > 0
Markiana nigripinnis: 1 > 0
Cheirodon stenodon: 1 > 0
Node 297: 1 > 01
Charax stenopterus: 01 > 0
Node 306: 01 > 1
Node 295: 01 > 0
Cheirodon jaguaribensis: 1 > 0
Node 413: 1 > 0
Phenagoniates macrolepis: 1 > 0
Node 415: 1 > 0
Hyphessobrycon megalopterus: 1 > 0
Node 410: 0 > 1
Paracheirodon simulans: 1 > 0
Node 425: 1 > 0
Char. 321 (6 steps)
Root: 0
Node 248: 0 > 2
Node 258: 0 > 2
Node 255: 2 > 02
Node 406: 2 > 0
Agoniates anchovia: 02 > 0
Node 399: 2 > 1
Bario steindachneri: 2 > 1
Char. 322 (9 steps)
Root: 1
Node 248: 1 > 0
Hemiodus cf. *thayeria*: 1 > 0
Node 258: 1 > 0
Node 406: 0 > 1
Tetragonopterus argenteus: 0 > 1
Stichonodon insignis: 0 > 1
Node 400: 0 > 1
Astyanax asuncionensis: 0 > 01
Astyanax cf. *abramis*: 0 > 01
Astyanax cf. *asuncionensis*: 0 > 01
Moenkhausia hemigrammoides: 1 > 01
Nematocharax venustus: 0 > 01
Node 396: 0 > 1
Node 361: 0 > 1
Char. 323 (1 step)
Root: 0
Stethaprion erythrops: 0 > 1
Char. 324 (7 steps)
Root: 01
Puntius tetrazona: 01 > 1
Distichodus maculatus: 01 > 0
Node 248: 01 > 0
Node 247: 01 > 0
Node 242: 01 > 1
Node 261: 01 > 1
Node 251: 01 > 1
Prochilodus lineatus: 0 > 1
Node 258: 01 > 0
Node 264: 01 > 0
Chalceus macrolepidotus: 01 > 1
Brycon pesu: 0 > 1
Char. 325 (7 steps)
Root: 0
Node 267: 0 > 1
Rhaphiodon vulpinus: 0 > 01
Lonchogenys ilisha: 0 > 1
Node 386: 0 > 1
Charax stenopterus: 0 > 1
Hyphessobrycon compressus: 0 > 1
Roeboides descalvadensis: 0 > 1
Node 375: 0 > 1
Char. 326 (1 step)
Root: 0
Node 267: 0 > 1
Char. 327 (10 steps)
Root: 0
Node 267: 0 > 1
Thoracocharax stellatus: 0 > 1
Node 270: 0 > 1
Node 309: 0 > 1
Rhaphiodon vulpinus: 0 > 1
Poptella paraguayensis: 1 > 01
Markiana nigripinnis: 0 > 1
Node 296: 0 > 01
Node 295: 01 > 1
Paragoniates alburnus: 0 > 1
Roeboides descalvadensis: 01 > 0
Roeboides microlepis: 01 > 1
Bario steindachneri: 0 > 1
Char. 328 (17 steps)
Root: 0
Distichodus maculatus: 0 > 1
Node 309: 0 > 1
Markiana nigripinnis: 0 > 1
Node 400: 0 > 1
Node 420: 0 > 1
Nematocharax venustus: 0 > 1
Aphyodite grammica: 0 > 1

Node 364: 0 > 1
Node 390: 0 > 1
Node 421: 0 > 1
Hemigrammus tridens: 0 > 1
Parecbasis cyclolepis: 0 > 1
Node 342: 0 > 1
Parapristella georgiae: 0 > 1
Hemigrammus erythrozonus: 1 > 01
Microschemobrycon casiquiare: 0 > 01
Bryconamericus alpha: 0 > 01
Pristella maxillaris: 0 > 1
Aulixidens eugeniae: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 329 (1 step)
Root: 0
Node 253: 0 > 1
Char. 330 (11 steps)
Root: 0
Engraulisoma taeniatum: 0 > 1
Node 266: 0 > 1
Node 264: 0 > 1
Node 268: 0 > 1
Node 358: 0 > 1
Node 351: 0 > 1
Node 329: 0 > 1
Node 333: 0 > 1
Node 294: 0 > 1
Node 401: 1 > 0
Gymnocharacinus bergii: 0 > 1
Char. 331 (5 steps)
Root: 0
Node 266: 0 > 1
Node 268: 0 > 2
Node 263: 0 > 1
Xenagoniates bondi: 0 > 1
Node 338: 0 > 1
Char. 332 (9 steps)
Root: 1
Puntius tetrazona: 1 > 01
Node 249: 1 > 0
Pyrrhulina australis: 0 > 1
Prochilodus lineatus: 1 > 0
Node 268: 0 > 1
Node 305: 0 > 01
Agoniates anchovia: 0 > 1
Hoplocharax goethei: 01 > 1
Lonchogenys ilisha: 01 > 1
Heterocharax macrolepis: 01 > 0
Node 297: 0 > 1
Aphyodite grammica: 0 > 1
Char. 333 (3 steps)
Root: 1
Node 258: 1 > 0
Node 255: 0 > 01
Node 254: 01 > 1
Node 297: 0 > 1
Char. 334 (1 step)
Root: 0
Node 244: 0 > 1
Char. 335 (10 steps)
Root: 0
Node 249: 0 > 1
Pyrrhulina australis: 1 > 0
Piabucus melanostomus: 1 > 0
Lonchogenys ilisha: 1 > 01
Inpaichthys kerri: 1 > 0
Prodontocharax melanotus: 1 > 0
Prionobrama paraguayensis: 1 > 0
Hyphessobrycon luetkenii: 1 > 01
Hyphessobrycon elachys: 1 > 0
Axelrodia lindeae: 1 > 01
Aphyocharacidium bolivianum: 1 > 01
Node 316: 1 > 0
Pristella maxillaris: 1 > 0
Piabina argentea: 1 > 01
Creagrutus anary: 1 > 0
Char. 336 (9 steps)
Root: 1
Node 253: 1 > 01
Node 261: 01 > 0
Node 246: 1 > 0
Node 267: 01 > 0
Engraulisoma taeniatum: 01 > 1
Node 258: 01 > 1
Node 265: 01 > 0
Thoracocharax stellatus: 01 > 0
Carnegiella strigata: 01 > 1
Salminus brasiliensis: 1 > 0
Brycon orbignyanus: 1 > 0
Markiana nigripinnis: 1 > 0
Creagrutus anary: 1 > 0
Char. 337 (6 steps)
Root: 1
Puntius tetrazona: 1 > 01
Node 252: 1 > 01
Node 251: 01 > 0
Node 259: 01 > 0
Node 267: 01 > 1
Rhaphiodon vulpinus: 0 > 1
Node 371: 0 > 01
Exodon paradoxus: 01 > 1
Attonitus ephimeros: 0 > 1
Aphyocharax dentatus: 0 > 01
Piabina argentea: 0 > 1
Char. 338 (1 step)
Root: 0
Node 248: 0 > 1
Char. 339 (24 steps)
Root: 0
Node 248: 0 > 02
Characidium rachovii: 02 > 2
Metynnis maculatus: 0 > 1
Node 305: 0 > 2
Psellogrammus kennedyi: 0 > 1
Hyphessobrycon griemi: 0 > 1
Cheirodon stenodon: 0 > 1
Node 315: 0 > 2
Node 298: 0 > 2
Node 381: 0 > 1
Node 417: 0 > 2
Hyphessobrycon elachys: 0 > 1
Parecbasis cyclolepis: 2 > 0
Aphyocharacidium bolivianum: 2 > 1
Node 428: 0 > 2
Hemigrammus unilineatus: 0 > 1
Parapristella georgiae: 0 > 1
Node 303: 2 > 1
Hyphessobrycon pulchripinnis: 2 > 1
Hyphessobrycon ecuadoriensis: 1 > 0
Aulixidens eugeniae: 0 > 1
Node 409: 1 > 01
Node 375: 1 > 0
Bryconella pallidifrons: 01 > 0
Node 425: 01 > 012
Brittanichthys axelrodi: 01 > 0
New Genus: 012 > 1
Hyphessobrycon axelrodi: 012 > 2
Char. 340 (2 steps)
Root: 0
Hyphessobrycon elachys: 0 > 2
Node 446: 0 > 2
Char. 341 (22 steps)
Root: 0
Metynnis maculatus: 0 > 1
Node 270: 0 > 01
Salminus brasiliensis: 0 > 01
Node 289: 0 > 1
Brycon pesu: 01 > 1
Acestrorhynchus pantaneiro: 0 > 1
Psellogrammus kennedyi: 1 > 01
Markiana nigripinnis: 1 > 0
Node 391: 1 > 0
Node 277: 1 > 0
Cheirodon stenodon: 1 > 0
Node 383: 1 > 01
Node 388: 01 > 0
Node 274: 0 > 01
Node 364: 1 > 01
Node 381: 01 > 0
Node 439: 01 > 1
Node 414: 01 > 0
Parecbasis cyclolepis: 0 > 1
Aphyocharax dentatus: 01 > 1
Astyanax parahybae: 1 > 0
Hyphessobrycon compressus: 1 > 0
Hemigrammus unilineatus: 1 > 0
Acestrocephalus sardina: 1 > 0
Node 361: 01 > 1
Node 415: 1 > 0
Pseudocorynopoma doriae: 1 > 0
Moenkhausia dichroura: 01 > 0
*Hyphessobrycon ecuad*oriensis: 0 > 1
Hasemania hanseni: 0 > 01
Hyphessobrycon bentosi: 1 > 01
Bryconella pallidifrons: 0 > 1
Char. 342 (15 steps)
Root: 0
Node 289: 0 > 1
Stichonodon insignis: 1 > 0
Stethaprion erythrops: 1 > 0
Node 353: 1 > 0
Hyphessobrycon anisitsi: 1 > 01
Astyanax courensis: 0 > 1
Node 280: 1 > 0
Node 348: 0 > 1
Astyanax jacuhiensis: 1 > 0
Node 441: 0 > 1
Node 311: 0 > 01
Hemigrammus ocellifer: 0 > 1
Nematocharax venustus: 01 > 1
Bryconamericus iheringii: 0 > 1
Node 332: 0 > 01
Node 442: 0 > 1
Bryconamericus cf. *iheringii*: 01 > 1
Hyphessobrycon bentosi: 0 > 01
Node 436: 0 > **1**
Char. 343 (6 steps)
Root: 0
Moenkhausia hemigrammoides: 0 > 1
Node 422: 0 > 1
Node 417: 0 > 1
Hemigrammus ulreyi: 1 > 01
Microschemobrycon melanotus: 0 > 1
Hyphessobrycon amandae: 0 > 1
Node 408: 0 > 1
Char. 344 (4 steps)
Root: 0
Node 305: 0 > 1
Cheirodon stenodon: 0 > 1
Hemigrammus tridens: 0 > 1
Coptobrycon bilineatus: 0 > 1
Brittanichthys axelrodi: 0 > 01
Char. 345 (10 steps)
Root: 0
Hemiodus cf. *thayeria*: 0 > 2
Hemigrammus ocellifer: 0 > 3
Ectrepopterus uruguayensis: 0 > 3
Node 273: 0 > 1
Node 405: 0 > 2
Hemigrammus bleheri: 0 > 1
Node 398: 0 > 3
Hyphessobrycon negodagua: 0 > 3
Bryconamericus exodon: 0 > 3
Hyphessobrycon megalopterus: 0 > 3
Char. 346 (1 step)

Root: 0
Node 267: 0 > 1
Char. 347 (7 steps)
Root: 0
Node 407: 0 > 1
Node 348: 0 > 01
Node 347: 01 > 1
Node 431: 0 > 1
Astyanax lineatus: 01 > 0
Astyanax cf. *asuncionensis*: 01 > 1
Moenkhausia hemigrammoides: 0 > 01
Hasemania kalunga: 0 > 01
Hemigrammus tocantinsi: 0 > 01
Moenkhausia sanctaefilomenae: 0 > 1
Ectrepopterus uruguayensis: 0 > 01
Hyphessobrycon compressus: 0 > 01
Parapristella georgiae: 0 > 01
Coptobrycon bilineatus: 0 > 1
Paracheirodon axelrodi: 0 > 01
Paracheirodon simulans: 0 > 01
Paracheirodon innesi: 0 > 01
Brittanichthys axelrodi: 0 > 1
Char. 348 (3 steps)
Root: 0
Hyphessobrycon boulengeri: 0 > 01
Hemigrammus ocellifer: 0 > 1
Moenkhausia sanctaefilomenae: 0 > 01
Moenkhausia forestii: 0 > 01
Node 439: 0 > 1
Hyphessobrycon negodagua: 0 > 1
Bario steindachneri: 0 > 01
Char. 349 (5 steps)
Root: 02
Node 241: 02 > 0
Puntius tetrazona: 02 > 2
Node 242: 0 > 1
Node 246: 0 > 2
Thoracocharax stellatus: 0 > 1
Node 268: 0 > 1
Char. 350 (9 steps)
Root: 1
Node 268: 1 > 01
Piabucus melanostomus: 01 > 0
Salminus brasiliensis: 1 > 0
Node 287: 1 > 0
Gymnocorymbus ternetzi: 1 > 01
Node 356: 0 > 01
Astyanax chico: 01 > 1
Node 347: 0 > 1
Node 293: 0 > 1
Node 295: 0 > 1
Node 316: 0 > 01
Node 334: 0 > 1
Bryconamericus thomasi: 0 > 01
Cheirodon interruptus: 01 > 1
Nantis indefessus: 0 > 01
Char. 351 (4 steps)
Root: 0
Node 248: 0 > 1
Leporinus striatus: 0 > 1
Node 377: 0 > 01
Coptobrycon bilineatus: 01 > 1
Gymnocharacinus bergii: 01 > 0
Grundulus cochae: 01 > 1
Char. 352 (5 steps)
Root: 0
Node 279: 0 > 01
Node 278: 01 > 1
Phenacogaster tegatus: 0 > 1
Aphyocharax nattereri: 1 > 0
Node 319: 1 > 0
Node 335: 1 > 0
Char. 353 (2 steps)
Root: 0
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Node 320: 0 > 1
Char. 354 (2 steps)
Root: 0
Node 320: 0 > 1
Mimagoniates rheocharis: 1 > 0
Char. 355 (2 steps)
Root: 0
Node 321: 0 > 01
Node 320: 01 > 1
Mimagoniates rheocharis: 1 > 0
Char. 356 (5 steps)
Root: 0
Puntius tetrazona: 0 > 01
Node 261: 0 > 1
Characidium rachovii: 0 > 01
Carnegiella strigata: 0 > 1
Hasemania kalunga: 0 > 1
Hasemania nana: 0 > 01
Node 379: 0 > 1
Phenagoniates macrolepis: 0 > 1
Char. 357 (1 step)
Root: 0
Node 352: 0 > 1
Char. 358 (4 steps)
Root: 0
Hollandichthys multifasciatus: 0 > 1
Node 320: 0 > 1
Attonitus ephimeros: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 359 (9 steps)
Root: 0
Node 268: 0 > 01
Piabucus melanostomus: 01 > 1
Markiana nigripinnis: 0 > 1
Node 391: 0 > 02
Node 324: 0 > 1
Node 311: 0 > 01
Hollandichthys multifasciatus: 02 > 2
Nematocharax venustus: 01 > 1
Cyanocharax alegretensis: 1 > 0
Node 362: 0 > 1
Nematobrycon palmeri: 0 > 1
Brittanichthys axelrodi: 0 > 1
Char. 360 (3 steps)
Root: 0
Node 391: 0 > 01
Hollandichthys multifasciatus: 01 > 1
Node 320: 0 > 01
Node 319: 01 > 1
Brittanichthys axelrodi: 0 > 1
Char. 361 (2 steps)
Root: 1
Node 261: 1 > 0
Node 346: 1 > 01
Microschemobrycon casiquiare: 01 > 0
Char. 362 (7 steps)
Root: 1
Puntius tetrazona: 1 > 01
Node 261: 1 > 0
Carnegiella strigata: 1 > 01
Node 264: 1 > 01
Node 374: 1 > 01
Brycinus carolinae: 01 > 0
Node 373: 01 > 0
Gymnocorymbus ternetzi: 1 > 01
Astyanax mexicanus: 1 > 01
Hyphessobrycon griemi: 1 > 01
Node 420: 1 > 01
Hemigrammus ocellifer: 01 > 0
Moenkhausia sanctaefilomenae: 1 > 01
Moenkhausia forestii: 1 > 01
Node 346: 1 > 01
Hasemania nana: 1 > 01
Astyanax parahybae: 1 > 0
Hemigrammus erythrozonus: 1 > 01
Thayeria obliqua: 1 > 01
Microschemobrycon casiquiare: 01 > 0
Hyphessobrycon pulchripinnis: 1 > 01
Pristella maxillaris: 1 > 01
Hyphessobrycon eques: 1 > 01
Hyphessobrycon haraldschultzi: 1 > 0
Paracheirodon axelrodi: 1 > 01
Char. 363 (13 steps)
Root: 01
Node 249: 01 > 0
Node 243: 01 > 1
Node 267: 0 > 1
Thoracocharax stellatus: 0 > 01
Carnegiella strigata: 0 > 01
Chalceus macrolepidotus: 0 > 1
Node 406: 0 > 01
Triportheus nematurus: 01 > 1
Rhaphiodon vulpinus: 0 > 1
Tetragonopterus argenteus: 0 > 01
Gymnocorymbus ternetzi: 0 > 01
Hyphessobrycon griemi: 0 > 01
Markiana nigripinnis: 0 > 1
Node 278: 0 > 1
Node 300: 0 > 01
Node 299: 01 > 1
Node 424: 0 > 01
Node 346: 1 > 01
Node 423: 01 > 1
Node 274: 1 > 01
Node 273: 01 > 0
Hemigrammus erythrozonus: 0 > 01
Microschemobrycon casiquiare: 01 > 0
Hyphessobrycon socolofi: 0 > 1
Pristella maxillaris: 1 > 01
Hyphessobrycon eques: 1 > 01
Hyphessobrycon haraldschultzi: 1 > 0
Paracheirodon axelrodi: 0 > 01
Char. 364 (3 steps)
Root: 01
Node 249: 01 > 0
Node 243: 01 > 1
Node 267: 0 > 1
Thoracocharax stellatus: 0 > 01
Carnegiella strigata: 0 > 01
Chalceus macrolepidotus: 0 > 01
Rhaphiodon vulpinus: 0 > 1
Char. 365 (1 step)
Root: 0
Node 266: 0 > 1

CAPÍTULO 2

Redescription of *Astyanax luetkenii* (Boulenger, 1887) from Southern Brazil (Characiformes: Characidae)

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Abstract

Astyanax luetkenii is redescribed based on the type material and new collected specimens. The species was originally described from the laguna dos Patos system, Rio Grande do Sul, Brazil. The taxonomic revision of it's populations reveals a wide distribution in the laguna do Patos, rio Uruguay, rio Negro, rio Paraguay, rio Tramandaí and rio Mampituba systems. The species is diagnosed by having incomplete or interrupted lateral line with 9-18 perforated scales, teeth in the inner row of premaxilla with six to seven cusps, anal-fin with iii-v, 20-24 rays and the presence of a vertically elongate and relatively rounded humeral spot with a narrow extension ventrally, giving a general comma shape.

Resumo

Astyanax luetkenii é redescrita baseado no material tipo e em novos material coletados. A espécie foi originalmente descrita para o sistema da laguna do Patos, Rio Grande do Sul, Brasil. A espécie é diagnosticada pela presença de linha lateral incompleta ou interrompida com 9-18 escamas perfuradas, dentes na série interna do pré-maxilar com seis a sete cúspides, nadadeira anal com iii-v, 20-24 raios e pela presença de uma mancha umeral verticalmente alongada e relativamente arredondada com uma extensão estreita ventralmente, conferindo um formato geral de vírgula.

Key words: Taxonomy, Neotropical fish, Laguna dos Patos system, *Hyphessobrycon*.

Introduction

Astyanax Baird & Girard and *Hyphessobrycon* Durbin are among the most species rich genera of the family Characidae with more than 270 spp. collectively (Eschmeyer & Fong, 2013), and present a wide distribution in the Neotropical region south of Mexico to La Plata river basin in Argentina, with a higher diversity in South America (Lima & Moreira, 2003).

Hyphessobrycon luetkenii (Boulenger, 1887) is known for in laguna do Patos, rio Uruguay, rio Tramandaí, rio Mampituba, rio Cubatão, rio Paraiba do Sul in Rio de Janeiro State, rio Paraná and rio Paraguay basins (Lima *et al*., 2003; López *et al*., 2003; Schifino *et al*., 2004; Abilhoa & Bastos, 2009; Malabarba *et al*., 2013). Different populations of this species show complete or incomplete (interrupted) lateral line, a usually used to distinguish *Astyanax* from *Hyphessobrycon*.

The phylogenetic relationships among the species of the genera *Astyanax* and *Hyphessobrycon* with other Characidae still remains unclear. Mirande (2009, 2010) proposed a phylogeny for the family Characidae, including tentative phylogenetic diagnoses of the included subfamilies and monophyletic clades of Characidae. In these analyzes, *H. luetkenii* was recovered as belonging to the *Astyanax* clade in the hypothesis of Mirande (2009), while in Mirande (2010) this species is in a clade denominated "*H. luetkenii* clade" along with *H. bifasciatus* Ellis, 1911 and *A. latens* (Mirande, Aguilera & Azpelicueta, 2004). However, Mirande (pers. comun.) later found that his material of *H. luetkenii* was misidentified and does not belong to this species; therefore, these hypotheses must not be taken into account. More recently, Carvalho (2011) hypothesized the relationships among *Hysphessobrycon* "rosy tetra" species, and redefined *Hyphessobrycon stricto sensu* based on the analysis of *H. compressus* (Meek, 1904). The new monophyletic clade does not include *H. luetkenii*.

In the previous chapter of this current thesis, some *Astyanax* species from coastal drainages of eastern of Brazil and more species of *Deuterodon* Eigenmann were added to the Carvalho (2011) phylogenetic analysis matrix to hypothesize the relationship of these species that share similar some characters related to the color pattern of the humeral spot and teeth shape. A new monophyletic clade was recognized, including *Hyphessobrycon luetkenii* along with *A. giton* Eigenmann, 1908, *A. hastatus* Myers, 1928, *A. intermedius* Eigenmann, 1908, *A. jenynsii* (Steindachner, 1877), *A. parahybae* Eigenmann, 1908, *A. ribeirae* Eigenmann, 1911) and *A. taeniatus* (Jenyns, 1842). This clade is denominated "*A. ribeirae* clade", that was recovered as a sister group to the monophyletic genus *Deuterodon*. *Hyphessobrycon luetkenii* was transferred to the genus *Astyanax* that better conforms to the current knowledge about its relationships. These results corroborated with some previous studies (Travassos, 1957; Lucena & Lucena, 1992, 2002; Melo, 2001) that pointed out a possible "*H. luetkenii* species complex", including *A. giton*, *A. hastatus*, closely related to *Deuterodon*. The overall goal of this work is to provide a redescription of *A. luetkenii*, with an emphasis on the actual distribution of the species.

Material and Methods

The specimens examined are deposited in the Academy of Natural Science, Philadelphia (ANSP); Natural History Museum, London (BMNH); California Academy of Sciences, San Francisco (CAS); Departamento de Zoologia e Botânica, IBILCE/UNESP, São José do Rio Preto (DZSJRP); Museu de Ciências e Tecnologia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP); Museum of Comparative Zoology Harvard University, Cambridge, Massachusetts (MCZ); Museu de História Natural Capão da Imbuia, Curitiba (MHNCI); Museu de Biologia Prof. Mello Leitão (MBML); Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP); Naturhistorisches Museum, Vienna (NMW); Departamento de Zoologia, Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS); National Museum of Natural History, Smithsonian Institution, Washington (USNM). In the list of materials examined, the catalog number is followed by the number of specimens counted and measured range length of the specimens in the lot.

Counts were taken as described by Fink & Weitzman (1974), with modifications from Lima & Moreira (2003) with the exception of the number of scale rows below the lateral line, which followed Bertaco & Lucena (2006). Additional measurements are as follows; Head depth - vertical measurement taken at the posterior termination of the supraoccipital process, Pelvic to anal-fin distance – measured from origin of the pelvic fin to origin of the anal fin, and Dorsal to adipose-fin distance – measured from the base of the last dorsal-fin ray to the origin of the adipose fin. Counts of vertebrae, supraneurals, gill-rakers on the first arch, teeth, and procurrent caudal-fin rays were taken from cleared and stained (c&s) specimens prepared according to Taylor & van Dyke (1985). Vertebral counts include the four vertebrae of the Weberian apparatus, and the terminal centrum counted as a single element. The redescription is based on type material and material from laguna dos Patos system. In the description, an asterisk indicates counts of the lectoype. Measurements were taken point to point on the left side of the specimens with a caliper whenever possible. Measurements are expressed as percentage of standard length (SL) except for subunits of the head, which are presented as percents of head length (HL). The lateral line is considered “complete” when all scales or the last two consecutive scales are not perforated, “interrupted” when three or more consecutive scales are not perforated, and “incomplete” when a low number of scales are perforated solely in the anterolateraly region of body.

Lower and upper jaws of c&s specimens were photographed on a stereomicroscope Leica S6D in the Produtora do Campus do Vale - Produvale (Instituto de Biociências, UFRGS).

The laguna dos Patos system includes the laguna dos Patos, laguna Mirim and all their tributaries, and the rio Tramandaí system includes the rio Maquiné, rio Três Forquilhas and coastal lagoons interconnected to the rio Tramandaí, according to Malabarba (1989) and Malabarba & Isaia (1992), respectively. The geographic variation of *A. luetkenii* was investigated considering the following subunits (listed from South to North): rio Negro, rio Uruguay, laguna dos Patos, rio Tramandaí, rio Mampituba, rio Araranguá, rio Tubarão, rio Cubatão Sul, rio Itajaí, rio Cubatão Norte (Santa Catarina State), Litorânea (Paraná State), Leste (São Paulo, Rio de Janeiro, Espiríto Santo and Bahia States) and rio Paraguay. The analysis of geographic variation of the counts of *A. luetkenii* was performed with SigmaPlot 10.0 for Windows 7. The measurements were compared by Principal Component Analysis (PCA) discussed by Bookstein *et al*. (1985:101), populations were also analyzed according to the protocol of Reis *et al*. (1990) for Canonical Variable Analysis (CVA), the software PAST 1.8 (Hammer & Harper, 2003) was used in both analysis. Basic descriptive statistics and statistical tests for meristic data follow Malabarba & Weitzman (1999).

Results

***Astyanax luetkenii* (Boulenger, 1887)**

(Fig. 2)

Tetragonopterus Luetkenii. – Boulenger, 1887: 173 (description, type-locality: San Lorenzo, Rio Grande do Sul, Brazil, identification key).

Tetragonopterus lütkenii. - Eigenmann & Eigenmann, 1891: 53 (repeat Boulenger 1887).

Chirodon Lütkenii. - Ihering, 1893: 114-115 (distribution: Saco da Mangueira, Rio Grande do Sul).

Hemigrammus luetkenii. - Cope, 1894: 91 (redescription, distribution: rio Jacuhy).

Hemigrammus Luetkeni. - Ihering, 1898: 178 (distribution: Saco da Mangueira, Rio Grande, Rio Grande do Sul).

Hemigrammus interruptus no (Lütken). - Fowler, 1906: 335 (rio Jacuhy, same material than *Hemigrammus luetkenii* of Cope, 1894).

Hyphessobrycon lütkeni. - Ellis, 1911: 159 (new combination). Eigenmann, 1918: 206 - 208 (redescription, distribution: Rio Grande do Sul and Paraguay basins).

Hyphessobrycon luetkenii. - Fowler, 1948: 125 (repeat Ellis, 1911). Buckup & Malabarba, 1983: 106 (distribution: Taim Ecological Station). Malabarba, 1989: 135 (distribution: laguna dos Patos system). Britski *et al.*, 1999: 43 (distribution: rio Paraguay system). Lima *et al*., 2003: 137 - 138 (valid species). López *et al*., 2003: 27 (distribution: Argentina). Casciotta *et al*., 2003: 104 (distribution: laguna Iberiá, Argentina). Menni, 2004: 77 (distribution: Argentina). Abilhoa & Bastos, 2009: 10 (distribution: rio Cubatão basin, Paraná). Mirande, 2009: 32 (relationships within Characidae). Mirande, 2010: 512 (relationships within Characidae).

Hyphessobrycon lütkenii. - Grosser & Hahn, 1981: 64 (distribution: lagoa Negra, Viamão).

Hyphessobrycon luetkeni. - Almirón *et al*., 2004: 674 (distribution: rio Uruguay system). Almirón *et al*., 2006: 895 (distribution: rio de la Plata, Argentina). Miquelarena & López, 2010: 6 (distribution: rio Uruguay system).

Diagnosis. *Astyanax luetkenii* differs from most congeners by the presence of an incomplete or interrupted lateral line (*vs*. complete lateral line) and by the dentary teeth gradually decreasing in size posteriorly (*vs*. dentary teeth abruptly decreasing in size posteriorly) except from *A. ribeirae* (Fig. 3), *A. giton* (Fig. 4), *A. intermedius*, *A. hastatus* (Fig. 5), *A. burgerai* Zanata & Camelier, 2009, *A. epiagos* Zanata & Camelier, 2008, *A. jacobinae* Zanata & Camelier, 2008, *A. pelecus* Bertaco & Lucena, 2006 and *A. taeniatus*. From the species belonging to the *A. scabripinnis* species complex cited above (*A. burgerai*, *A. epiagos*, *A. intermedius* and *A. jacobinae*), *A. luetkenii* differs by the higher number of branched anal-fin rays (20-24 *vs*.13-21) and by the general body form (body elongated and heaviest at dorsal fins *vs*. body deepest and heaviest over middle of pectorals fins), from *A. ribeirae* by the presence of hook on the pelvic fins of males mature (present *vs.* absent), by the number of the cusps in the inner row of premaxilary teeth (6-7 *vs*. 8, 11) respectively in *A. giton* and *A. hastatus*, from *A. pelecus* by the number of branched anal-fin rays (20-24 *vs*. 16-18), and from *A. taeniatus* by the number of scales in the longitudinal line (30-35 *vs*. 40).

Description. Morphometric data summarized in Tables 1-7. Body compressed and elongate, greatest body depth anterior to dorsal-fin origin. Dorsal profile of head straight or slightly convex from posterior nostril to tip of supraoccipital spine. Dorsal body profile convex from tip of supraocciptal spine to base of last dorsal-fin ray; slightly convex from latter point to adipose fin origin. Ventral profile of body slightly convex from vertical through posterior nostril to pectoral fin origin, nearly straight between pelvic and anal fins and along anal fin base. Caudal peduncle elongate, nearly straight to slightly concave on the dorsal and ventral margins. Snout rounded from margin of upper lip to vertical through anterior nostrils. Head small. Mouth terminal, lower jaw slightly longer than upper jaw. Maxilla extending posteriorly to vertical through anterior margin of orbit, slightly curved, aligned at angle of approximately 45 degrees to longitudinal body axis. Maxilla slightly widened anteroposteriorly.

Premaxilla with 2 teeth rows, outer row with 2 to 3 teeth (3*, rarely 1 or 4 teeth) bearing 3-7 (5*) cusps, central cusp longer. Inner row with 5 teeth (5*, rarely 4 teeth), central cusp longer, first four teeth close of simphisis with wider base, last tooth distinctly smaller, with 6 to 7 cusps. Maxilla with 2 to 3 teeth (2*) with similar size, central cusp slightly longer like a “hand”, with 5 to 7 cusps. Dentary with 8 to 10 teeth, three to four anteriormost dentary teeth larger, with 5 or 7 cusps followed by three smaller teeth with central cusps not so conspicuous; teeth decreasing gradually in size posteriorly. All cusp tips slightly curved posteriorly towards inside mouth.

Dorsal-fin rays ii,9* (ii,9, three specimen with i,9, n = 144). First unbranched ray approximately half length of second ray. Dorsal-fin origin approximately at middle of SL. Adipose-fin slightly anterior to vertical through last anal-fin ray insertion. Anal-fin rays iii-v, 20-24 (iii, 21*, two specimens with 19 and two with 25, mean = 22.1, n = 144), anal-fin origin posterior to vertical through base of last dorsal-fin ray. Pectoral-fin rays i, 10-12 (i, 8*), two specimens with 9 and one with 13, mean = 10.9, n = 144), pectoral-fin tip trespasses pelvic-fin insertion. Pelvic-fin rays i, 6-8 (i, 7*, one specimen with 5, mean = 7.0, n = 144), pelvic fin origin slightly anterior to vertical through dorsal-fin origin. Pelvic-fin tip trespasses genital opening, not reaching anal-fin origin. Caudal-fin forked, lobes with similar size, 19* principal rays. Dorsal procurrent rays 8-12 (n = 16), and ventral procurrent rays 8-10 (n = 16).

Lateral line incomplete or interrupted with 9-18 perforated scales (15*, 4 specimens with lateral line complete and 20 specimens with lateral line interrupted, mean = 12.7, n = 144). Scales in longitudinal line (32*, mean = 33.4, n = 144). Scale rows between dorsal-fin origin and lateral line 5-6 (6*, mean = 5.7, n = 144); 4-6 scale rows between lateral line and pelvic-fin origin (5*, mean = 5, n = 144). Predorsal scales 8-11 (9*, one specimen with 12, mean = 9.9, n =144) arranged in regular series.

Scale rows around caudal peduncle 13-15 (15*, one specimen with 12, mean = 13.8, n = 144). Axillary scale on pelvic fin origin extends posteriorly covering 2 scales. Scale sheath along anal fin base 4-12 (5*, mean = 6.6, n = 139) scales, in single series, covering base of anteriormost rays.

Precaudal vertebrae 14-15 (n = 21); caudal vertebrae 17-20 (n = 21); total vertebrae 33-35 (n = 21). Supraneurals 4-5 (n = 21). Gill-rakers on upper branch 6-8 (mean = 7.7, n = 5), lower branch 9-13 (mean = 11.1, n = 5).

Sexual dimorphism. Males with retrorse bony hooks on pelvic and anal-fin rays. One or two paired bony hooks per lepidotrichia on distal portions of last unbranched anal-fin ray and first to eighth branched anal-fin rays. One paired bony hook per lepidotrichia on entire first to sixth pelvic-fin branched rays. Anal fin profile slightly concave to straight in males, concave in females. All specimens of type series without bony hooks on fins.

Coloration in alcohol. Dorsal and dorsolateral portions of head and body dark brown. One humeral spot conspicuous, vertically elongate with superior portion wider and with an inferior narrow extension, giving a “comma shape”, located over third to fifth vertical series of scales, extending over 3 to 4 horizontal series of scales above lateral line; inferior portion of spot narrow (2 scales pigmented), extending over 1 horizontal series of scales below lateral line. Body with black and narrow midlateral stripe extending from humeral spot to caudal fin base; faint dark pigmentation present on middle caudal-fin rays. Midlateral body stripe expanded dorsally and ventrally to caudal fin base, forming small caudal spot, extending over to 3 scales in horizontal series in diamond shape. Fins with dispersed dark chromatophores.

Coloration in life. Specimens after few days in formalin with body coloration golden dorsally to humeral spot and silvery ventrally humeral spot. Odd fins orange and yellowish pigmented.

Geographic variation. *A. luetkenii* is known from laguna dos Patos, rio Uruguay, rio Negro, rio Paraguay, rio Tramandaí and rio Mampituba drainages (Fig. 1). In laguna dos Patos system, rio Uruguay, rio Negro and rio Paraguay drainages, the incomplete lateral line pattern is predominantly found with few specimens presenting interrupted lateral lines. The main diference among these populations is related to the range of number of perforated scales on the lateral line. While the population from laguna dos Patos shows perforated scales between 9^{th} and 18^{th} scales, rio Uruguay presents a range between 8^{th} to 14^{th} scales, rio Negro between 10^{th} to 15^{th} , and rio Paraguay presents the shorter lateral line, with a range between 6^{th} to 12^{th} scales. The rio Tramandaí and rio Mampituba drainages represent the North limit of the distribution of the species along the East coast of Brazil. In these drainages two species are recognized: *A. luetkenii* (interrupted and incomplete lateral line) and *A. ribeirae* (complete lateral line).

Notes about syntypes of *A. luetkenii*. Boulenger originally designated seven specimens to the type series, four specimens being considered adults and three juveniles. These specimens were separated in two lots of syntypes based on their sizes. The four larger specimens in BMNH 1886.3.15.35-38 and the three smaller ones in BMNH 1885.2.3.78-80. After examination of all material, it was verified that the smallest specimen in BMNH 1885.2.3.78-80 is an individual of *Hyphessobrycon igneus* (Miquelarena, Menni, López & Casciotta, 1980), as just observed by Carvalho (2011). This specimen received a new collection number BMNH 1885.2.3.80. One specimen of type series is herein designated as lectotype (BMNH 1886.3.15.35) and the other individuals are designated as paralectotypes (BMNH 1886.3.15.36-38 and BMNH 1885.2.3.78-79).

Material examined. **Lectotype:** BMNH 1886.3.15.35, lectotype, 1, 55.8 mm SL, San Lorenzo, Rio Grande do Sul, Brazil; BMNH 1886.3.15.36-38, 3, 55.9-62.5 mm SL, collected with lectotype; BMNH 1885.2.3.78-79, paralectotypes 2, 34.3-35.6 mm SL, collected with lectotype. **Non-types: Brazil: Rio Grande do Sul: laguna dos Patos system:** UFRGS 807, 5, 51.8-63.1 mm SL, rio Caí, São Sebastião do Caí. UFRGS 2371, 7, 27.0-46.5 mm SL, locality of Passo dos Carros, Guaíba. UFRGS 3161, 10, 26.4-41.0 mm SL, lagoa Mangueira, Rio Grande. UFRGS 3191, 7, 36.7-44.9 mm SL, lagoa Mangueira, Rio Grande. UFRGS 3196, 3, 27.3-41.2 mm SL, Guaíba. UFRGS 3609, 5, 24.7-30.5 mm SL, açude, on the highway Charqueadas-São Jerônimo. UFRGS 3681, 10, 30.6-54.3 mm SL, locality of Barra do Adalto, Tapes. UFRGS 5134, 10 (5 c&s), 39.0-46.6 mm SL, tributary of rio Tainhas, Tainhas. UFRGS 5178, 4, 33.6-40.1 mm SL, rio Vacaria, São Gabriel. UFRGS 5270, 10 (5 c&s), 38.3-49.7 mm SL, lagoa do Palácio, Viamão. UFRGS 5610, 10 (4 c&s), 30.7-40.3 mm SL, arroio Ribeiro, Barra do Ribeiro. UFRGS 6612, 10, 39.8-57.6 mm SL, arroio Candiota, Candiota. UFRGS 6813, 5, 36.2-54.2 mm SL, arroio do Pinto, São Francisco de Paula. UFRGS 7599, 10, 36.9-42.6 mm SL, arroio Basílio, Herval. UFRGS 7600, 5 (2 c&s), 30.6-47.7 mm SL, tributary of rio Camaquã, Encruzilhada do Sul. UFRGS 8750, 10, 39.6-50.4 mm SL, Amaral Ferrador. UFRGS 8860, 5, 32.5-57.6 mm SL, açude at Fazenda Santa Margarida, Santa Margarida do Sul. **Brazil: Rio Grande do Sul: rio Uruguay system:** UFRGS 5256, 6, 25.1-35.1 mm SL, rio Ibicuí Mirim on the road Cacequi-São Vicente, Cacequi. UFRGS 5294, 10 (2 c&s), 23.5-29.1 mm SL, arroio do Salso, Rosário do Sul. UFRGS 7035, 4, 29.7-43.5 mm SL, arroio on the road to Pirapó, São Nicolau. UFRGS 10800, 10, 23.75-34.75 mm SL, rio Ijuizinho, Entre-Ijuís. **Uruguay: Província de Paysandu: rio Uruguay system:** UFRGS 7941, 10, 37.6-49.3 mm SL, arroyo Chapicuy Ciuco, tributary of rio Uruguay. **Uruguay: Província de Tacuarembó, rio Negro system:** UFRGS 7223, 10, 27.8-43.1 mm SL, arroyo Corrales, rio Tacuarembó, Rivera. UFRGS 7291, 5, 31.06-4.4 mm SL, rio Negro, en el Puente sobre la ruta 44, Rivera. **Província de Durazno:** UFRGS 7434, 15 (2 c&s), 33.3-43.8 mm SL, arroyo Maestre de Campo, tributary of rio Durazno. **Brazil: Rio Grande do Sul: rio Tramandaí system:** MCP 25320, 11, 46.2-59.1 mm SL, locality of Itati, rio Três Forquilhas, Terra de Areia. UFRGS 2206, 12 (2c&s), 28.3-39.5 mm SL, rio Maquiné, Osório. UFRGS 3865, 5, 31.6-51.8 mm SL, lagoa Itapeva, Torres. UFRGS 3867, 4, 49.4-59.6 mm SL, poças marginais a Interpraias, Capão Novo. UFRGS 9299, 3, 19.7-23.8 mm SL, on the highway Capivari-Mostardas, Mostardas. UFRGS 11512, 7, (2 c&s), 43.6-56.4 mm SL, lagoa Bacopari, Mostardas. UFRGS 13293, 3, 39.8-42.6, mm SL, lagoa Rondinha, Pinhal. **Brazil:**

Rio Grande do Sul: rio Mampituba system: MCP 23702, 7, 39.7-49.2 mm SL, rio Mampituba on the road between Mourinhos do Sul and Praia Grande, Mampituba. **Bazil: Mato Grosso do Sul: rio Paraguay system:** DZSJRP 12104, 5, 35.5-46.9 mm SL, arroio Olaria, Bonito. DZSJRP 12087, 5, 40.0-53.0 mm SL, arroio Olaria, Bonito. DZSJRP 12117, 5 (2 c&s), 43.2-47.9 mm SL, arroio Olaria, Bonito. **Paraguay:** ANSP 169722, 3, 19.4-20.1 mm SL, stream crossing Cacupe-Tobati road 7.0 km from Route 2 in the direction of Tobati. ANSP 169723, 2, 24.2-31.6 mm SL, pools 200 m West of Puente Remanso. ANSP 169724, 2, 22.8-23.9 mm SL, approx. 2 km stretch of unnamed arroyo that runs through Guarambare. ANSP 170308, 2, 21.5-25.1 mm SL, culvert pool and roadside ditch on road from Ayolas to main Asuncion/Encarnacion highway (Ruta 1). ANSP 170311, 3, 30.1-31.6 mm SL, pools on Rancho Salmo 23, approx. 8 km towards Clorinda from Puente Remanso. USNM 181811, 10, 22.1-33.8 mm SL, arroyo, 143 Km from Asuncion on the highway to Florida. USNM 207667, 3, 25.1-28.3 mm SL, arroyo Pachango, rio Tebicuary, Locality of Pueblo Ybytymi. USNM 397861, 10, 24.4-33.9 mm SL, arroyo Pachango, rio Tebicuary, Locality of Pueblo Ybytymi. USNM 327312, 2, 33.8-41.4 mm SL, Asuncion.

Discussion

Tetragonopterus luetkenii was described from the laguna dos Patos system by Boulenger (1887). The new species was characterized by the presence of "lateral line not continuing to the tail, extending on from ten to sixteen scales". However, the genus *Tetragonopterus* proposed by Cuvier (1816) based on the description of *Tetragonopterus argenteus* had been characterized by the presence of a lateral line complete and strongly bent downward at its anterior portion. Ellis (1911) transferred *Tetragonopterus luetkenii* to *Hyphessobrycon* based on the presence of an incomplete lateral line. After this recent phylogenetic analysis (see previous chapter), *Hyphessobrycon luetkenii* was transferred to *Astyanax*, with an update of its distribution, from the rio Uruguay basin to coastal rivers of Rio de Janeiro State (Lima *et al*., 2003; López *et al*., 2003; Schifino *et al*., 2004; Abilhoa & Bastos, 2009; Malabarba *et al*., 2013).

This study evidenced that *A. luetkenii* presents different patterns of perforation on the lateral line scales along its distribution. All type material of *A. luetkenii* present an incomplete lateral line, with poring ranging from 10^{th} to 15^{th} scales, fitting the range found in the new material from lagunda dos Patos system 9 to 18 perforated scales. Boulenger (1887), in the original description of *Tetragonopterus luetkenii*, was not clear about the lateral line perforation pattern of the new species. He mentioned that the lateral line was "not continued to the tail", but did not described the presence of interrupted scales. Eigenmann (1918), redescribed the species based on more material from Rio Grande do Sul and rio Paraguay system. He examined 1421 specimens and pointed out the lateral line having pores in 5 to 20 scales, six specimens presenting a complete lateral line, and only one with interrupted lateral line. The presence of an interrupted lateral line was found in twenty specimens in several different rivers of the laguna dos Patos system. A similar pattern was found in populations of rio Uruguay, rio Negro and rio Paraguay systems. In all these drainages, the percentage of individuals that have interrupted perforation on lateral line was around 5% of all examined material (Fig. 6).

Although the distribution of *A. luetkenii* is known to the rio Tramandaí and rio Mampituba systems, the specimens analyzed from these drainages presented a different pattern compared to the individuals from the drainages mentioned above. About half of all examined specimens from both drainages presented a complete lateral line, while the other half presented an interrupted lateral line and an incomplete lateral line.

Eigenmann (1917) delineated the lateral line presence with two states, "lateral line complete" *vs*. "lateral line incomplete". Eigenmann recognized that even genera that shared an interrupted lateral line could not be closely related to each other and probably originated from different lines of evolution. Malabarba (1998) commented on the inclusion of the complete or interrupted lateral line as character on phylogenetic analyzes is responsible for a reduction of consistency index and foran increasing the shortest tree length, even in small lineage of Characidae, where the lateral line completeness is shown to be highly homoplastic and poorly informative to species relationships. The same results were found and corroborated by Mirande (2010). Based on the current morphometric analysis, we could not find differences between the specimens with interrupted and incomplete lateral line. The laguna do Patos, rio Uruguay, rio Negro and rio Paraguay drainages show the dominant presence of an incomplete lateral line, and in rio Tramandaí and rio Mampituba drainages the dominant pattern of lateral line is interrupted, instead the incomplete, we are considering this condition a populational variation among the different drainages.

Although the lateral line character of Eigenmann has been largely used to diagnose genera with a complete or an incomplete lateral line, the most recent analysis are demonstrating the intermediate character, "interrupted" as not a strong determinant for defining species groups. We are recognizing two different *Astyanax* species among the populations from rio Tramandaí and rio Mampituba drainages, based on the presence of lateral line status (incomplete/interrupted *vs*. complete). The lateral line that presents a few scales pores that are not perforated do not represent a significant state of lateral line character to designate a different species.

In addition to *A. luetkenii* in rio Tramandaí and rio Mampituba drainages, *A. ribeirae*, described by Eigenmann (1911) is herein recognized be these systems based on material collected in coastal rivers of Paraná and São Paulo State. Oyakawa *et al*. (2006) and Menezes *et al*. (2007) considered this species endemic to the rio Ribeira do Iguape system. Oliveira (2011) recorded the occurrence of *A. ribeirae* in rio Ribeira do Iguape and Atlantic drainages of the State of Paraná (Litorânea), corroborating Eigenmann (1911, 1927). More recently, Oliveira (personal comm.) extended the distribution of *A. ribeirae* to rio Tramandaí system.

Considering a similar morphometric data (Tables 6-13), shape pattern of humeral spot and dentition, the only character used to separed *A. luetkenii* of *A. ribeirae* is the completeness of a lateral line. The type material of *A. ribeirae* was not studied in this current work and all the comparative data of this species are from the original description by Eigenmann (1911) and the most recent redescription by Oliveira (2011) based on 35 specimens from rio Ribeira do Iguape basin to Atlantic rivers from Paraná State, including the holotype and paratypes. Therefore, though the similarities morphologicals and the overlap of morphometric data among the two species are very close to each other, the synonymization of *A. ribeirae* to *A. luetkenii* is a strong tendency for the next studies, but for while, due the no analysis of type material of *A. ribeirae* and the the lack of studies on the evolution patterns of lateral line, we prefer to keep both species as noninals. Thereby, the most meriodional limit the distribution of species *A. ribeirae* is designated to rio Tramandaí and rio Mampituba systems (sympatric with *A. luetkenii* in these drainages), and corroborate Oliveira's information.

Among the species *Astyanax* from coastal dranaiges of eastern Brazil (North to rio Ribeira do Iguape system), the following present the dentary teeth gradually decreasing in size posteriorly: *A. giton*, *A. intermedius*, *A. hastatus*, *A. burgerai*, *A. epiagos*, *A. jacobinae*, *A. pelecus* and *A. taeniatus*. From those, *A. burgerai*, *A. epiagos*, *A. intermedius* and *A. jacobinae* belong to *A. scabripinnis* species complex, a non-monophyletic group characterized for a low number of branched anal-fin rays (13-21) and for body shape (body deepest and heaviest at vertical over middle of pectoral fin) (Moreira-Filho & Bertollo, 1991; Bertaco & Malabarba, 2001; Bertaco & Lucena, 2006). Regarding the other species, mentioned above, that do not belong to *A. scabripinnis* (*A. giton*, *A. hastatus*, *A. pelecus* and *A. taeniatus*), *A. pelecus* presents a similar dentition pattern with the species cited above with other characters such as: presence of a midlateral body stripe extending from the upper margin of the opercle, the possession of 16-18 branched anal-fin rays, 38-39 scales in the lateral-line series, and four scales between the lateral line and the pelvic-fin origin (Bertaco & Lucena, 2006), exclude this species from *A. ribeirae* clade (according phylogenetic analysis in the previous chapter). About *A. giton*, *A. hastatus* and *A. taeniatus*, these species are morphologically similar to *A. luetkenii* and *A. ribeirae* in the color pattern and shape of humeral spot and dentary teeth and showed a close relationship with the *A. luetkenii* and *A. ribeirae*.

The analyzed material includes all the three species, including the type material of *A. hastatus*, but due the low number of specimens analyzed of *A. taeniatus* and the lack a better definition of the species, once the original description by Jenyns (1842) is very dubia, in addition to the examination of its type material, the discussion herein is more focused on *A. giton* (Table 14) and *A. hastatus* (Table 15).

Eigenmann (1908) described *A. giton* based on two specimens from rio Parahyba, and defined the new species as resembling *A. taeniatus* with a blunt snout. In 1921, the same author examined the cototype and redescribed the species; however, no additional morphological data were added to the redescription. Melo (2001) revised the *Astyanax* species from Serra dos Órgãos and analyzed some specimens from the rio Paraíba do Sul drainage and small drainages flowing into the Baía da Guanabara, including *A. giton* and *A. hastatus*. According to Melo (2001), *A. hastatus* shows the interopercle posterior expanded over part of subopercle, eleven cups on teeth of inner row of premaxilla (*vs*. eight in *A. giton*), and presents bony hooks on the males caudal fin (*vs*. absence of bony hooks on the males caudal fin in *A. giton*). The material herein analyzed, previously identified as *A. luetkenii* from rivers of Leste system, present a complete lateral line being related to *A. giton*, according to the review of Melo (2001).

The morphometric data analyzed by percentages and PCA of populations of the three species recognized herein did not reveal any discrimination among populations of *A. luetkenii* and *A. ribeirae* (Fig. 7). Although, *A. giton* can be partially discriminated from the other two populations. *Astynax luetkenii* and *A. ribeirae* populations show a closer relationship among other indicated by strong values overlap close to the second axis. The morphometric data analyzed by CVA, when the intrapopulation influence of the size (growth) is removed, maximizing the interpopulation components of variation (Reis *et al*., 1990), revealing a better discrimination and resolution of the three analized populations (Fig. 8).

Regarding the meristic analysis, there was an overlap of all data ranges. On the number of anal-fin branched rays (Fig. 9) and longitudinal scales (Fig. 10), the populations from rio Cubatão and Litorânea systems presented the higher median values compared to other populations.

The dentition, other important character to used to define genera and species in Characidae, presented some differences in the shape of the jaws among the species treated herein: 1) the ascending process of maxilla in *A. luetkenii* and *A. hastatus* are more robust than in *A. ribeirae*, with a smaller lamellar expansion on the ventral margin, near the teeth; in *A. giton* (except in the most anterior ascending process of maxilla) the bone presents the similar width; 2) the ascending process of the maxilla is as long as the lamellar posterior portion in *A. luetkenii* and *A. giton,* while in *A. ribeirae* and *A. hastatus* the posterior lamellar portion is slightly longer; 3) in *A. luetkenii* the ventral margin of the posterior lamellar portion of the maxilla begins immediately after the last tooth, while in *A. ribeirae* there is a small gap between the last tooth and the ventral margin; and, 4) the dorsoposterior margin of lower jaw is smoothly convex in *A. luetkenii* and slightly deeper after the last tooth, while in *A. giton* it is sharply rounded from the last posterior tooth to the anguloarticular- quadrate condyle (Fig. 11-13).

The current distribution of *A. luetkenii* and the recognition of *A. ribeirae* and *A. giton* in all range of distribution where *A. luetkenii* used to be identified, based on the morphological analysis, corroborate with previous studies about distribution and endemism of other Characidae groups (Menezes, 1988; Vari, 1988; Bizerril, 1994).

Vari (1988) analyzed the distribution patterns of Curimatidae populations in the Neotropical region and recognized two regions in the South of the Amazon basin where the endemism among curimatid species are more pronounced: (1) the upper rio Paraná system, and (2) the area consisting of the rio Paraguay, the lower rio Paraná, the rio Uruguay, the laguna dos Patos system and small coastal rivers of southeastern Brazil (Rio Grande do Sul State and South of São Paulo State). The second group of Curimatidae's distribution pattern corroborates partially the distribution found to *A. luetkenii*, wherein, laguna do Patos, rio Uruguay and rio Paraguay systems present a very close relationship and represent part of these species distribution.

In studies of the distribution pattern of *Oligosarcus* Günther species in Central and Southern America, Menezes (1988) suggests the recognition of three endemic areas of distribution for the coastal species of *Oligosarcus*: (1) South Coastal Subregion (lagoa dos Patos, lagoa Mirim and some smaller ones), formed in the Quaternary (Schwarzbold & Schafer, 1984); (2) the Central Coastal Subregion, apparently continuous with the former subregion during the Wisconsin Glaciation (60.000-16.000 years B.P.), from southern end of the Serra do Mar at Cabo de Santa Marta and (3) North Coastal Subregion. Endemicity of some Characidae species other than *Oligosarcus* seem to corroborate the three coastal subregions, such as: *Pseudocorynopoma doriae* Perugia, 1891, *Mimagoniates inequalis* (Eigenmann, 1911) and *Hyphessobrycon meridionalis* Ringuelet, Miquelarena & Menni, 1978 (South Coastal Subregion); *Mimagoniates lateralis* (Nichols, 1913), *Rachoviscus crassiceps* Myers, 1926 and *Hyphessobrycon griemi* Hoedeman, 1957 (Central Coastal Subregion); *Rachoviscus graciliceps* Weitzman & Cruz, 1981, *Hyphessobrycon flammeus* Myers, 1924 and *Spintherobolus broccae* Myers, 1925 (North Coastal Subregion) (Menezes, 1988; Weitzman *et al*., 1988; Menezes *et al*., 2008).

These biogeographical models of endemism reinforces the pattern observed in *A. ribeirae* clade, where *A. luetkenii* is found in South Coastal Subregion and the other two species, *A. ribeirae* and *A. giton*, are found in the Central Coastal Subregion and North Coastal Subregion, respectively, corroborating the hypothesis that several Characidae groups had a similar vicariant process and speciation on the Brazilian East Coast.

Bizerril (1994), based on the taxonomic composition of the fish fauna from the East drainages and the rate of endemism in each portion, also recognized two subprovinces: a) Subprovince Southeast Coast (from South border of the state of Santa Catarina to the highlands of Rio de Janeiro); and b) Subprovince East Coast (from North of Rio de Janeiro to the mouth of the rio São Francisco).

Although, the borders and limits of the endemic subregions or subprovinces can change according to different studies, the common idea is that laguna do Patos, rio Uruguay, rio Negro and rio Paraguay systems presents a similar species distribution pattern related to Andean formation, while rio Tramandaí and rio Mampituba systems are more closely related to the transformations of the coastal plain, being isolated more recently, and the other coastal systems from the Leste system to the mouth of rio São Francisco had a different geological and vicariant processes than the drainages into the North and the South of these boundaries.

More recently Carvalho (2007), based on parsimony analysis of endemism of 83 fish species, suggested that the northern limit of the South coastal area of endemism extends farther North of the Cabo de Santa Marta to the Serra do Tabuleiro (the limits of the remaining areas do not coincide with those of Menezes (1988)). The limits, origins, and relationships of areas of endemism along the eastern margin of the Brazilian Shield are still poorly known despite increasing knowledge about Neotropical fish diversity (Buckup, 2011).

Comparative material. *Astyanax* sp.: CAS 11847, 1, 63.8 mm SL, rio Feio, São Paulo. CAS 53461, 6, 26.0-39.6 mm SL, northwest of Rio de Janeiro, from Macaé on Alcindo Guanabara Road, Rio de Janeiro. CAS 68437, 1, 49.2 mm SL, vicinity of Rio de Janeiro, Rio de Janeiro. USNM 257506, 6, 62.6-66.9 mm SL, rio dos Coitinhos, between Angra dos Reis and Rio Claro, Rio de Janeiro. USNM 257509, 10, 30.3-67.1 mm SL, tributary of rio Macaé, Fazenda Torreão, Rio de Janeiro. USNM 257519, 10, 30.4-69.4 mm SL, south branch of rio Tavares, São Paulo. USNM 257520, 10, 38.5-74.5 mm SL, rio Puruba, São Paulo. USNM 257521, 10, 34.6-54.6 mm SL, rio Seco, tributary to lago de Saquarema, along Rd Amaral Peixoto between Sampaio Correia and Bacaxa, Rio de Janeiro. USNM 285638, 3, 28.9-36.4 mm SL, Santo Ângelo, Rio Grande do Sul. USNM 318482, 5, 26.4-32.9 mm SL, rio Mucuri, Presidente Pena, Minas Gerais. USNM 318487, 5, 44.0-82.5 mm SL, tributary of rio Jequitinhonha, Jordania, Minas Gerais. USNM 318491, 5, 30.2-51.6 mm SL, rio Mucuri, Minas Gerais. USNM 318492, 5, 36.4-39.4 mm SL, tributary of rio Jequitinhonha, Jordania, Minas Gerais. USNM 32190, 5, 33.5-45.6 mm SL, tributary of rio Jequitinhonha, Jordania, Minas Gerais. USNM 337614, 18, 18.5-57.4 mm SL, rio Forqueta, Lajeado, Rio Grande do Sul. USNM 385238, 10, 32.1-60.0 SL mm, rio da Areia, Rio de Janeiro. USNM 181467, 10, 22.9-40.9 mm SL, arroyo, 143 Km from Asuncion on highway to Florida, Paraguay. *Astyanax brevirhinus*: MCZ 20905, holotype, 51.5 mm SL, rio Jequitinhonha, along the Jequitinhonha Valley. *Astyanax eigenmanniorum*: ANSP 21598, holotype, 54.2 mm SL, Rio Grande do Sul. ANSP 21627-21628, paratypes, 2, 43.4-51.0 mm SL, collected with holotype. ANSP 21599-21601, paratypes, 3, 38.3-49.7 mm SL, collected with holotype. ANSP 21602, paratype, 1 c&s, collected with holotype. USNM 337595, 2, 67.8-77.0 mm SL, arroio Chasqueiro, Pelotas, Rio Grande do Sul. USNM 337604, 10, 28.4-61.9 mm SL, arroio Vieira, Rio Grande, Rio Grande do Sul. USNM 337613, 1, 43.6 mm SL, arroio Bolacha, Rio Grande, Rio Grande do Sul. USNM 337616, 1, 52.1 mm SL, arroio Sarandi, Pelotas, Rio Grande do Sul. *Astyanax giton*: CAS 68500, 1, 78.1 mm SL, rio Doce, Minas Gerais. MCP 34420, 1 c&s, 49.2 mm SL, córrego Boa Vista, tributary of rio Itabapoana, Mimoso do Sul, Espiríto Santo. MCP 36771, 1 c&s, 31.1 mm SL, córrego Palmares, tributary of do rio Itaúnas, Pinheiros, Bahia. MZUSP 27563, 4, 32.9-39.2 mm SL, Rio de Janeiro and vicinity, Rio de Janeiro. MZUSP 3672, 25, 10.6-54.6 mm SL, Angra dos Reis, Rio de Janeiro. UFRGS 14814, 2 c&s, 47.9-49.9 mm SL, córrego Latão, tributaty of Rio Doce, Coimbra, Minas Gerais. USNM 129919, 1, 18.6 mm SL, rio Macaé, Torreão, Minas Gerais. USNM 318467, 4, 23.8-36.9 mm SL, rio Itaunas, Espírito Santo. USNM 320209, 1, 31.7 mm SL, tributary of rio Tanque, Itabira, Minas Gerais. USNM 320279, 5, 18.8-32.0 mm SL, córrego on the road Castelo/Muniz Freire, Espírito Santo. USNM 320281, 4, 23.5-33.1 mm SL, rio Taquarucu, on the road Br 381, Ipatinga, Minas Gerais. *Astyanax* cf. *giton*: MBML 1468, 5, 53.4-67.2 mm SL, tributary of rio Barri, Bahia. MBML 1481, 5, 35.6-47.8 mm SL, Guaratinga, Bahia. MBML 1530, 5, 50.9-67.4 mm SL, Bahia. MBML 1541, 5, 44.5-57.5 mm SL, rio dos Frades, Porto Seguro, Bahia. *Astyanax hastatus*: UFRGS 10257, 2 c&s, 49.3-49.9 mm SL, Macacu, Rio de Janeiro. USNM 94312, paratypes, 15, 22.0-37.0 mm SL, Southeastern Brazil. *Astyanax intermedius*: CAS 11772, 1, 70.6 mm SL, Nova Friburgo, Rio de Janeiro. UFRGS 10821, 2 c&s, 59.3-62.5 mm SL, Santa Virginia, São Paulo. *Astyanax janeiroensis*: MCZ 21057, holotype, 72.0 mm SL, Rio de Janeiro. UFRGS 13690, 1, 73.8 mm SL, córrego on the road, Iguape, São Paulo. *Astyanax jenynsii*: CAS 68735, 1, 85.3 mm SL, rio Ribeira do Iguape, São Paulo. NMW 576534, syntypes, 3, 62,3-72.8 mm SL, rio Parahyba. *Astyanax jequitinhonnae*: CAS 11776, 1, 58.7 mm SL, rio São Francisco, Pirapora, Minas Gerais. *Astyanax parahybae*: CAS 68775, 4, 50.1-64.9 mm SL, rio Paraíba, Campos, Rio de Janeiro. CAS 57610, 5, 72.9-95.2 mm SL, rio Parahyba, Rio de Janeiro. MCZ 157903, paralectotypes, 5, 79.3-98.3 mm SL, rio Parahyba, Mendez, Miriahe and Taubaté, USNM 120245, syntypes, 3, 86.3-96.6 mm SL, collected with paralectotypes. *Astyanax ribeirae*: MCP 11010, 10, 22.9-65.8 mm SL, rio Capivari on the road Gravatal/Armazém, Gravatal, Santa Catarina. MCP 11082, 9, 19.5-66.9 mm SL, rio Capivari, Gravatal, Santa Catarina. MCP 15397, 3 c&s, 31.9-36.3 mm SL, rio Côrrea, Tubarão, Santa Catarina. MCP 15468, 3 c&s, 37.4-41.9 mm SL, arroio Lindo, Joinville, Santa Catarina. MCP 16488, 10, 35.3-58.8 mm SL, ribeirão São Luis, Apiuna, Santa Catarina. MCP 19178, 20 (3c&s), 35.4-51.5 mm SL, rio Itoupava, Ermo, Santa Catarina. MCP 19204, 10, 48.0-57.1 mm SL, rio São Bento, Siderópolis, Santa Catarina. MCP 22308, 3 c&s, 29.0-35.7 mm SL, rio Antinhas, Santa Catarina. MCP 23702, 3, 48.9-58.7 mm SL, rio Mampituba on the road between Mourinhos do Sul and Praia Grande, Mampituba, Rio Grande do Sul. MCP 25320, 4, 49.8-58.5 mm SL, locality of Itati, rio Três Forquilhas, Terra de Areia, Rio Grande do Sul. MCP 31503, 10, 33.7-52.7 mm SL, arroio do rio Cubatão, Joinville, Santa Catarina. MCP 31758, 3 c&s, 37.3-40.8 mm SL, arroio on the PR 404 in the way to Guaraqueçaba, Paraná. MCP 31756, 10, 34.2-61.0 mm SL, arroio tributary of the rio Nhundiaquara, Morretes, Paraná. MCP 42555, 8, 41.1-67.7 mm SL, lagoa do Peri, Parque Municipal da Lagoa do Peri, Florianópolis, Santa Catarina. UFRGS 2206, 8, 29.7-42.1 mm SL, rio Maquiné, Osório, Rio Grande do Sul. UFRGS 3865, 5, 40.4-49.6 mm SL, lagoa Itapeva, Torres, Rio Grande do Sul. UFRGS 3867, 6, 49.4-58.3 mm SL, poças marginais a Interpraias, Capão Novo, Rio Grande do Sul. UFRGS 6197, 15, 34.9-55.4 mm SL, rio Mãe Luzia, Trevisco, Santa Catarina. UFRGS 11512, 3, 49.1-50.4 mm SL, lagoa Bacopari, Mostardas, Rio Grande do Sul. UFRGS 12549, 2 c&s, 36.6-40.1 mm SL, rio Jordão, Nova Veneza, Santa Catarina. UFRGS 13293, 7, 36.3-44.1 mm SL, lagoa Rondinha, Pinhal, Rio Grande do Sul. USNM 381593, 1, 26.6 mm SL, between cities of Rio Fortuna and Santa Rosa de Cima, Santa Catarina. *Astyanax* cf. *rivularis*: CAS 53511, 1, 48.4 mm SL, locality of Parahybuna, Minas Gerais. *Astyanax taeniatus*: CAS 11789, 1, 52.2 mm SL, Piracicaba, São Paulo. CAS 11790, 1, 43.6 mm, Nova Friburgo, Rio de Janeiro CAS 11846, 76.6 mm SL, Santos, São Paulo. CAS 68803, 1, 55.0 mm SL, rio Parahyba. MCP 27322, 3, 52.9-55.6 mm SL, Itarana, Espírito Santo. UFRGS 10408, 1, 72.5 mm SL, rio Pandeiros, Januária, Minas Gerais. *Deuterodon iguape*: MCP 20914, 2 c&s, 32.1-61.1 mm SL, rio Betari, Iporanga, São Paulo. UFRGS 10352, 2 c&s, 38.8-52.7 mm SL, rio Cachoeira da Anta, Peruíbe, São Paulo. *Deuterodon langei*: MCP 13965, 2 c&s, 50.3-64.7 mm SL, rio São João, Pedra Branca, Paraná. *Deuterodon longirostris*: MCP 12205, 2 c&s, 72.8-73.8 mm SL rio do Cedro, Águas Mornas, Santa Catarina. NMW 57633, syntypes, 3, 69.1-75.0 mm SL, rio Cubatão, Santa Catarina, Theresopolis. *Deuterodon rosae*: MCP 12209, 1 c&s, 86.0 mm SL, arroio afluente do rio Itapocu, Corupa, Santa Catarina. *Deuterodon singlaris*: MCP 11084, paratype,1 c&s, 60.3 mm SL, rio Capivari, Gravatal Santa Catarina. *Deuterodon stigmaturus*: MCP 14678, 2 c&s, 45.6-70.6 mm SL, rio Maquiné, Maquiné, Rio Grande do Sul. *Deuterodon supparis*: MCP 10622, paratypes, 2 c&s, rio Itajaí-Açu, Santa Catarina.

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Table 1. Morphometric data of *Astyanax luetkenii*: lectotype (L, BMNH 1886.3.15.35, n = 1) and paralectotypes (BMNH 1886.3.15.36-38 and BMNH 1885.2.3.78-79, n = 5) from San Lorenzo, Rio Grande do Sul, Brazil.

	L	N	Range	Mean	SD
Standard length (mm)	55.8	5	34.3-62.5	50.1	-
Percents of standard length					
Body depth	40.3	5	35.3-42.2	38.7	2.1
Head depth	29.3	5	27.9-29.6	29.0	0.6
Predorsal distance	45.9	5	43.9-50.5	47.1	2.0
Preventral distance	44.7	5	43.3-47.1	45.0	1.6
Pelvic to anal-fin distance	16.4	5	15.6-20.1	17.6	1.6
Caudal peduncle depth	11.9	5	9.2-12.1	10.8	1.2
Dorsal-fin base	14.8	5	10.5-15.2	13.4	1.8
Anal-fin base	29.5	5	26.8-30.7	28.7	1.7
Pectoral-fin length	22.4	5	18.4-21.5	20.5	1.2
Pelvic-fin lengh	19.3	5	14.7-16.7	16.1	0.7
Dorsal-fin length	29.3	5	24.9-29.7	27.5	1.9
Anal-fin length	17.6	5	15.5-19.4	17.1	1.4
Caudal peduncle length	8.2	5	9.5-13.1	10.9	1.4
Dorsal to adipose-fin distance	40.4	5	33.2-43.8	39.3	2.2
Orbital to dorsal-fin distance	32.8	5	31.5-34.3	32.7	1.0
Dorsal to caudal peduncle distance	53.6	5	51.2-56.6	54.4	2.1
Head length	25.2	5	23.4-32.8	26.8	2.0
Percents of head length					
Orbital diameter	33.0	5	30.7-40.0	33.4	1.8
Snout length	21.4	5	16.4-18.6	17.7	1.0
Interorbital width	33.5	5	29.1-37.2	34.6	2.3
Premaxillary ramus	28.9	5	24.6-28.6	26.8	2.0

Table 2. Morphometric data of populations of *Astyanax luetkenii*. Laguna dos Patos system (n = 139).

	N	Range	Mean	SD
Standard length (mm)	139	19.7-57.6	38.9	-
Percents of standard length				
Body depth	139	32.8-45.5	39.0	2.0
Head depth	139	25.1-32.0	29.2	1.3
Predorsal distance	139	43.7-52.4	48.1	1.9
Preventral distance	139	38.4-49.2	43.1	1.9
Pelvic to anal-fin distance	139	15.3-22.0	18.3	1.4
Caudal peduncle depth	139	8.7-15.9	11.0	0.8
Dorsal-fin base	139	11.8-17.1	14.8	1.0
Anal-fin base	139	25.1-33.0	28.8	1.4
Pectoral-fin length	139	13.9-25.2	20.6	1.8
Pelvic-fin lengh	139	13.5-21.1	16.5	1.3
Dorsal-fin length	139	22.4-32.7	26.9	1.8
Anal-fin length	139	15.2-22.9	1813	1.5
Caudal peduncle length	139	7.1-13.8	10.7	1.1
Dorsal to adipose-fin distance	139	33.6-41.4	37.5	1.5
Orbital to dorsal-fin distance	139	27.7-36.5	32.1	1.8
Dorsal to caudal peduncle distance	139	46.7-56.8	52.9	1.8
Head length	139	23.8-29.8	25.9	1.2
Percents of head length				
Orbital diameter	139	30.9-45.3	39.0	1.9
Snout length	139	13.4-25.8	17.9	2.0
Interorbital width	139	27.0-39.6	33.6	1.9
Premaxillary ramus	139	20.2-33.7	26.4	2.0

Table 3. Morphometric data of populations of *Astyanax luetkenii*. Rio Uruguay system (n = 40).

	N	Range	Mean	SD
Standard length (mm)	40	23.5-49.3	32.1	-
Percents of standard length				
Body depth	40	31.7-44.9	38.4	2.4
Head depth	40	26.3-34.1	30.2	1.9
Predorsal distance	40	44.5-53.2	48.5	1.9
Preventral distance	40	38.7-49.5	44.4	2.3
Pelvic to anal-fin distance	40	14.0-22.2	18.2	1.6
Caudal peduncle depth	40	8.0-12.4	10.5	1.1
Dorsal-fin base	40	12.7-16.3	14.2	0.8
Anal-fin base	40	25.8-33.0	28.9	1.8
Pectoral-fin length	40	18.7-23.2	21.1	1.2
Pelvic-fin lengh	40	15.4-22.0	17.3	1.1
Dorsal-fin length	40	21.6-30.3	27.2	2.1
Anal-fin length	40	15.6-22.6	19.1	1.5
Caudal peduncle length	40	9.1-13.8	11.1	1.0
Dorsal to adipose-fin distance	40	34.6-42.8	37.9	1.6
Orbital to dorsal-fin distance	40	29.2-36.6	32.0	1.5
Dorsal to caudal peduncle distance	40	47.6-56.7	52.8	1.9
Head length	40	23.5-32.0	26.8	1.5
Percents of head length				
Orbital diameter	40	35.0-47.6	40.2	2.2
Snout length	40	13.1-23.4	16.1	2.1
Interorbital width	40	25.8-38.3	34.4	2.2
Premaxillary ramus	40	18.8-29.2	25.1	2.0

Table 4. Morphometric data of populations of *Astyanax luetkenii*. Rio Negro system (n = 30).

	N	Range	Mean	SD
Standard length (mm)	30	27.8-48.4	38.9	-
Percents of standard length				
Body depth	30	36.9-45.0	39.8	2.2
Head depth	30	28.5-35.6	31.3	1.8
Predorsal distance	30	46.8-53.6	49.5	1.4
Preventral distance	30	39.8-46.5	43.6	1.7
Pelvic to anal-fin distance	30	15.6-25.1	19.6	1.8
Caudal peduncle depth	30	9.2-13.0	10.8	0.8
Dorsal-fin base	30	12.6-15.7	13.9	0.7
Anal-fin base	30	26.4-32.9	29.7	1.5
Pectoral-fin length	30	19.0-25.2	21.5	1.4
Pelvic-fin lengh	30	14.1-19.6	16.6	1.1
Dorsal-fin length	30	22.6-30.2	26.7	1.4
Anal-fin length	30	14.7-21.6	18.2	1.5
Caudal peduncle length	30	8.7-12.1	10.1	0.7
Dorsal to adipose-fin distance	30	33.8-42.3	38.3	1.7
Orbital to dorsal-fin distance	30	30.3-40.8	34.0	1.9
Dorsal to caudal peduncle distance	30	50.4-57.0	53.3	1.4
Head length	30	24.5-31.8	27.1	1.6
Percents of head length				
Orbital diameter	30	31.4-40.2	36.6	1.6
Snout length	30	12.3-18.3	15.0	1.4
Interorbital width	30	29.3-36.8	33.6	1.9
Premaxillary ramus	30	18.4-28.5	23.6	2.2

Table 5. Morphometric data of populations of *Astyanax luetkenii*. Rio Paraguay system (n = 68).

	N	Range	Mean	SD
Standard length (mm)	68	19.2-53.0	31.1	-
Percents of standard length				
Body depth	68	29.9-41.9	35.5	2.1
Head depth	68	25.2-35.2	29.5	1.7
Predorsal distance	68	44.8-53.1	49.3	2.1
Preventral distance	68	40.3-50.9	45.8	2.1
Pelvic to anal-fin distance	68	12.8-22.3	17.0	2.1
Caudal peduncle depth	68	7.4-12.4	9.9	1.1
Dorsal-fin base	68	9.8-15.4	12.8	1.2
Anal-fin base	68	24.3-35.4	30.3	2.2
Pectoral-fin length	68	16.9-23.4	20.4	1.5
Pelvic-fin lengh	68	12.0-20.5	16.3	1.6
Dorsal-fin length	68	21.8-29.4	26.2	1.9
Anal-fin length	68	14.4-24.4	18.6	2.1
Caudal peduncle length	68	7.4-16.2	10.8	1.2
Dorsal to adipose-fin distance	68	31.1-40.7	36.3	2.1
Orbital to dorsal-fin distance	68	29.8-37.6	33.7	1.6
Dorsal to caudal peduncle distance	68	44.7-55.4	50.0	2.1
Head length	68	22.4-31.7	26.5	1.9
Percents of head length				
Orbital diameter	68	34.4 -42.9	3843	2.2
Snout length	68	13.3-22.8	17.6	1.9
Interorbital width	68	28.9-39.0	34.9	2.1
Premaxillary ramus	68	21.5-32.8	27.1	2.0

Table 6. Morphometric data of populations of *Astyanax luetkenii* and *A. ribeirae*. Rio Tramandaí system (n = 75).

	A. luetkenii				*A. ribeirae*			
	N	**Range**	**Mean**	**SD**	**N**	**Range**	**Mean**	**SD**
Standard length (mm)	42	28.3-59.6	44.8	-	33	29.9-58.5	44.6	-
Percents of standard length								
Body depth	42	33.7-43.1	38.5	1.9	33	35.3-42.4	38.8	1.7
Head depth	42	26.6-31.6	28.6	1.1	33	25.9-32.1	28.7	1.4
Predorsal distance	42	45.0-50.6	47.8	1.2	33	44.7-51.0	47.7	1.5
Preventral distance	42	40.2-48.0	43.6	1.4	33	40.0-47.2	43.0	1.8
Pelvic to anal-fin distance	42	17.9-23.1	21.0	1.2	33	18.3-24.9	21.2	1.6
Caudal peduncle depth	42	9.6-12.4	11.2	0.6	33	9.7-11.9	11.2	0.4
Dorsal-fin base	42	11.5-16.0	14.1	0.7	33	12.3-15.8	14.0	0.7
Anal-fin base	42	24.1-32.6	27.8	1.7	33	23.8-29.9	27.6	1.5
Pectoral-fin length	42	16.4-22.8	20.7	1.2	33	19.2-29.4	21.1	1.7
Pelvic-fin lengh	42	13.5-18.6	16.6	1.0	33	14.1-17.9	16.2	1.0
Dorsal-fin length	42	22.1-30.1	26.6	1.4	33	24.6-29.6	26.9	1.0
Anal-fin length	42	14.4-20.6	17.2	1.6	33	14.3-20.3	17.2	1.3
Caudal peduncle length	42	9.3-13.2	11.3	0.8	33	9.3-13.0	11.4	0.9
Dorsal to adipose-fin distance	42	34.3-41.3	38.7	1.4	33	36.5-41.4	38.9	1.2
Orbital to dorsal-fin distance	42	29.3-38.5	32.8	1.7	33	29.0-35.7	32.4	1.7
Dorsal to caudal peduncle distance	42	51.0-57.7	54.5	1.7	33	52.5-56.4	54.2	1.1
Head length	42	22.0-27.7	24.3	1.3	33	22.7-28.0	24.5	1.2
Percents of head length								
Orbital diameter	42	34.1-52.6	38.4	2.7	33	33.6-42.9	38.3	1.8
Snout length	42	13.6-20.0	16.2	1.3	33	12.2-18.6	15.9	1.6
Interorbital width	42	29.1-37.3	33.6	1.9	33	29.8-37.7	33.8	1.8
Premaxillary ramus	42	17.8-30.8	25.2	2.8	33	16.3-29.0	24.9	2.3

Table 7. Morphometric data of populations of of *Astyanax luetkenii* and *A. ribeirae*. Rio Mampituba system (n = 40).

	A. luetkenii				***A. ribeirae***			
	N	**Range**	**Mean**	**SD**	**N**	**Range**	**Mean**	**SD**
Standard length (mm)	18	39.7-55.2	48.7	-	22	45.2-58.7	51.8	-
Percents of standard length								
Body depth	18	34.2-40.3	37.6	1.5	22	34.5-40.2	37.4	1.5
Head depth	18	26.9-29.8	28.0	0.8	22	26.1-30.8	28.0	1.0
Predorsal distance	18	45.3-50.0	48.1	1.2	22	46.3-51.9	48.7	1.2
Preventral distance	18	40.4-45.8	43.3	1.8	22	42.6-47.7	44.7	1.3
Pelvic to anal-fin distance	18	18.0-21.2	19.9	0.7	22	17.8-22.4	20.1	1.2
Caudal peduncle depth	18	10.0-12.4	10.8	0.6	22	10.0-12.1	10.8	0.5
Dorsal-fin base	18	12.6-16.0	13.8	0.8	22	11.4-14.7	13.4	0.8
Anal-fin base	18	25.2-31.4	27.7	1.5	22	24.2-28.6	26.5	1.2
Pectoral-fin length	18	18.5-21.7	20.2	1.0	22	18.1-21.5	20.0	0.9
Pelvic-fin lengh	18	15.4-18.0	16.3	0.8	22	14.6-18.1	16.1	0.9
Dorsal-fin length	18	24.4-28.8	26.0	1.1	22	23.8-27.9	25.6	0.9
Anal-fin length	18	14.8-20.0	16.9	1.3	22	14.7-19.5	16.7	1.1
Caudal peduncle length	18	9.6-12.9	11.3	0.8	22	9.5-13.4	11.4	0.9
Dorsal to adipose-fin distance	18	36.6-40.9	38.4	1.3	22	35.2-41.1	38.1	1.3
Orbital to dorsal-fin distance	18	29.8-36.0	33.0	1.6	22	30.1-36.5	33.3	1.5
Dorsal to caudal peduncle distance	18	51.6-55.6	53.7	1.1	22	49.9-55.8	53.6	1.3
Head length	18	22.2-26.0	23.9	0.9	22	22.1-24.6	23.5	0.5
Percents of head length								
Orbital diameter	18	36.7-41.6	38.9	1.1	22	34.4-42.8	39.2	1.9
Snout length	18	12.8-18.3	16.1	1.6	22	14.2-18.9	16.0	1.2
Interorbital width	18	32.4-37.1	34.4	1.4	22	31.8-38.1	34.7	1.5
Premaxillary ramus	18	20.0-28.1	25.4	2.0	22	23.0-28.8	25.9	1.7

Table 8. Morphometric data of populations of *Astyanax ribeirae*. Rio Araranguá system (n = 45).

	N	Range	Mean	SD
Standard length (mm)	45	32.9-58.4	46.0	-
Percents of standard length				
Body depth	45	32.2-39.1	35.4	1.5
Head depth	45	25.5-29.8	35.4	0.2
Predorsal distance	45	45.5-53.1	48.1	1.3
Preventral distance	45	41.2-48.1	43.7	1.3
Pelvic to anal-fin distance	45	17.4-22.3	19.7	1.0
Caudal peduncle depth	45	9.6-11.9	10.8	0.5
Dorsal-fin base	45	12.1-15.5	13.9	0.7
Anal-fin base	45	25.3-29.6	27.3	1.1
Pectoral-fin length	45	19.7-23.0	21.1	0.8
Pelvic-fin lengh	45	15.1-19.4	17.2	0.8
Dorsal-fin length	45	23.9-29.7	26.9	1.1
Anal-fin length	45	14.2-19.9	17.0	0.9
Caudal peduncle length	45	9.5-14.3	11.7	0.8
Dorsal to adipose-fin distance	45	34.9-40.5	37.8	1.2
Orbital to dorsal-fin distance	45	29.8-36.2	32.6	1.3
Dorsal to caudal peduncle distance	45	50.7-56.7	53.8	1.0
Head length	45	22.3-25.7	23.6	0.8
Percents of head length				
Orbital diameter	45	33.5-44.2	39.7	2.5
Snout length	45	13.3-19.4	16.7	1.4
Interorbital width	45	31.8-39.4	36.4	1.5
Premaxillary ramus	45	21.9-31.4	26.7	2.3

Table 9. Morphometric data of populations of *Astyanax ribeirae*. Rio Tubarão system (n = 39).

	N	Range	Mean	SD
Standard length (mm)	39	19.5-67.9	36.6	-
Percents of standard length				
Body depth	39	31.9-40.5	35.4	2.0
Head depth	39	25.8-31.5	28.2	1.3
Predorsal distance	39	44.9-50.6	47.8	1.4
Preventral distance	39	40.7-48.6	44.2	1.9
Pelvic to anal-fin distance	39	16.1-23.4	19.2	1.5
Caudal peduncle depth	39	9.2-12.1	10.8	0.8
Dorsal-fin base	39	10.7-16.3	13.5	1.1
Anal-fin base	39	23.3-29.9	27.3	1.5
Pectoral-fin length	39	14.7-26.8	20.5	1.8
Pelvic-fin lengh	39	13.2-20.3	16.7	1.1
Dorsal-fin length	39	21.3-29.7	26.6	1.6
Anal-fin length	39	12.3-21.4	17.1	1.7
Caudal peduncle length	39	8.6-14.4	11.2	1.0
Dorsal to adipose-fin distance	39	34.8-39.6	37.4	1.1
Orbital to dorsal-fin distance	39	29.7-34.5	30.3	1.2
Dorsal to caudal peduncle distance	39	48.6-55.7	53.3	1.2
Head length	39	21.9-28.2	24.9	1.3
Percents of head length				
Orbital diameter	39	35.7-45.0	40.6	2.1
Snout length	39	14.3-20.6	18.0	1.3
Interorbital width	39	29.8-39.9	34.0	2.2
Premaxillary ramus	39	24.1-32.1	28.4	1.7

Table 10. Morphometric data of populations of *Astyanax ribeirae*. Cubatão Sul system (n = 8).

	N	Range	Mean	SD
Standard length (mm)	8	41.1-67.7	57.5	-
Percents of standard length				
Body depth	8	33.6-42.1	37.6	2.5
Head depth	8	25.8-29.2	27.8	1.1
Predorsal distance	8	45.5-48.8	47.4	1.2
Preventral distance	8	38.9-44.0	41.9	1.5
Pelvic to anal-fin distance	8	19.1-22.6	20.6	1.2
Caudal peduncle depth	8	10.4-12.0	11.1	0.5
Dorsal-fin base	8	12.8-14.6	13.6	0.7
Anal-fin base	8	26.1-32.1	29.0	2.0
Pectoral-fin length	8	21.8-25.0	23.2	1.0
Pelvic-fin lengh	8	17.2-20.7	18.6	1.3
Dorsal-fin length	8	26.3-28.7	27.3	0.8
Anal-fin length	8	14.5-18.3	16.7	1.1
Caudal peduncle length	8	9.7-11.8	10.6	0.7
Dorsal to adipose-fin distance	8	35.9-40.2	37.9	1.3
Orbital to dorsal-fin distance	8	30.5-34.8	32.5	1.4
Dorsal to caudal peduncle distance	8	53.0-56.4	54.5	1.0
Head length	8	22.8-24.2	23.5	0.4
Percents of head length				
Orbital diameter	8	38.0-43.7	40.6	1.6
Snout length	8	14.1-16.6	15.6	0.8
Interorbital width	8	33.1-36.0	34.5	1.0
Premaxillary ramus	8	25.7-29.6	27.7	1.5

Table 11. Morphometric data of populations of *Astyanax ribeirae*. Rio Itajaí system (n = 15).

	N	Range	Mean	SD
Standard length (mm)	15	28.24-61.17	43.7	-
Percents of standard length				
Body depth	15	34.1-40.1	37.6	1.7
Head depth	15	26.6-28.9	28.1	0.7
Predorsal distance	15	46.7-50.5	48.7	1.0
Preventral distance	15	41.2-45.9	44.1	1.2
Pelvic to anal-fin distance	15	18.1-22.5	20.2	1.3
Caudal peduncle depth	15	9.2-11.8	11.0	0.7
Dorsal-fin base	15	12.1-16.2	13.7	0.8
Anal-fin base	15	25.0-28.7	27.1	1.1
Pectoral-fin length	15	18.2-23.3	21.0	1.3
Pelvic-fin lengh	15	14.6-18.6	16.9	0.9
Dorsal-fin length	15	24.8-29.7	27.1	1.2
Anal-fin length	15	15.9-18.8	17.2	0.8
Caudal peduncle length	15	10.9-12.6	11.6	0.5
Dorsal to adipose-fin distance	15	35.1-40.4	37.6	1.2
Orbital to dorsal-fin distance	15	30.7-35.2	33.4	1.3
Dorsal to caudal peduncle distance	15	51.2-55.0	53.0	1.1
Head length	15	22.2-25.7	2404	1.0
Percents of head length				
Orbital diameter	15	35.8-41.0	39.1	1.4
Snout length	15	12.8-19.6	16.4	1.6
Interorbital width	15	33.5-37.9	35.5	1.2
Premaxillary ramus	15	23.5-31.4	27.8	2.1

Table 12. Morphometric data of populations of *A*styanx *ribeirae*. Rio Cubatão system (n = 30).

	N	Range	Mean	SD
Standard length (mm)	30	33.7-59.6	45.1	-
Percents of standard length				
Body depth	30	33.7-41.2	37.3	2.0
Head depth	30	26.2-31.0	28.5	1.1
Predorsal distance	30	46.0-51-9	48.8	1.3
Preventral distance	30	40.1-46.3	43.2	1.5
Pelvic to anal-fin distance	30	16.6-21.9	19.7	1.3
Caudal peduncle depth	30	9.3-11.7	10.7	0.5
Dorsal-fin base	30	11.1-14.1	12.9	0.8
Anal-fin base	30	26.4-30.7	28.4	1.3
Pectoral-fin length	30	19.5-24.9	22.0	1.1
Pelvic-fin lengh	30	16.7-23.2	17.8	1.3
Dorsal-fin length	30	24.1-28.8	26.9	1.2
Anal-fin length	30	15.1-20.2	17.5	1.2
Caudal peduncle length	30	9.9-12.8	11.3	0.7
Dorsal to adipose-fin distance	30	35.7-40.2	38.1	1.3
Orbital to dorsal-fin distance	30	30.2-38.6	33.2	1.6
Dorsal to caudal peduncle distance	30	51.7-56.1	53.7	1.1
Head length	30	22.4-26.1	24.1	0.9
Percents of head length				
Orbital diameter	30	38.1-47.1	4.11	1.8
Snout length	30	15.0-19.5	16.8	1.1
Interorbital width	30	32.0-39.4	35.0	1.9
Premaxillary ramus	30	25.9-34.2	29.1	2.0

Table 13. Morphometric data of populations of *A*styanax *ribeirae*. Litorânea system (n = 20).

	N	Min	Mean	SD
Standard length (mm)	20	33.2-61.0	43.6	-
Percents of standard length				
Body depth	20	36.3-44.5	39.1	2.2
Head depth	20	27.1-33.2	29.0	1.5
Predorsal distance	20	45.9-51.7	48.6	1.3
Preventral distance	20	41.2-49.8	43.8	2.2
Pelvic to anal-fin distance	20	17.6-23.3	19.5	1.6
Caudal peduncle depth	20	9.4-12.8	10.6	0.8
Dorsal-fin base	20	12.6-14.9	13.5	0.6
Anal-fin base	20	26.7-33.0	29.6	1.4
Pectoral-fin length	20	20.2-24.5	22.1	1.0
Pelvic-fin lengh	20	15.3-20.4	17.7	1.2
Dorsal-fin length	20	25.6-33.3	28.5	1.7
Anal-fin length	20	16.2-20.5	18.1	1.1
Caudal peduncle length	20	9.4-13.0	11.2	0.9
Dorsal to adipose-fin distance	20	33.8-43.3	38.0	1.9
Orbital to dorsal-fin distance	20	29.2-36.5	32.7	1.8
Dorsal to caudal peduncle distance	20	50.0-54.9	53.1	1.3
Head length	20	23.6-29.3	24.8	1.3
Percents of head length				
Orbital diameter	20	37.9-43.1	40.9	1.6
Snout length	20	12.9-19.9	17.3	1.9
Interorbital width	20	30.8-38.2	35.3	1.6
Premaxillary ramus	20	22.7-30.3	27.7	2.1

Table 14. Morphometric data of populations of *Astyanax giton*. Leste system (n = 39).

	N	Range	Mean	SD
Standard length (mm)	39	18.6-73.0	41.4	-
Percents of standard length				
Body depth	39	29.1-42.2	35.9	2.3
Head depth	39	24.4-33.0	28.7	2.2
Predorsal distance	39	43.1-51.3	47.3	1.8
Preventral distance	39	40.1-49.4	44.4	2.0
Pelvic to anal-fin distance	39	15.4-23.9	19.1	1.7
Caudal peduncle depth	39	9.5-13.1	11.1	0.9
Dorsal-fin base	39	10.4-15.7	12.7	1.7
Anal-fin base	39	22.8-33.4	26.9	2.1
Pectoral-fin length	39	18.0-24.7	21.5	1.4
Pelvic-fin lengh	39	15.2-20.8	17.8	1.1
Dorsal-fin length	39	24.5-30.4	27.4	1.5
Anal-fin length	39	15.3-23.0	19.2	1.7
Caudal peduncle length	39	9.5-13.9	11.2	1.0
Dorsal to adipose-fin distance	39	32.6-40.1	37.8	1.6
Orbital to dorsal-fin distance	39	27.2-35.2	31.3	1.6
Dorsal to caudal peduncle distance	39	47.2-59.4	53.4	2.3
Head length	39	22.6-30.7	26.0	1.7
Percents of head length				
Orbital diameter	39	35.7-45.5	40.5	2.1
Snout length	39	15.3-20.4	17.8	1.2
Interorbital width	39	30.2-38.2	35.0	2.0
Premaxillary ramus	39	24.1-37.6	30.6	2.2

Table 15. Morphometric data of *Astyanax hastatus*, paratypes (USNM 94312) from vicinity Rio de Janeiro (n=15).

	N	Range	Mean	SD
Standard length (mm)	15	22.0-37.0	29.4	-
Percents of standard length				
Body depth	15	28.2-35.8	32.1	2.2
Head depth	15	25.6-33.7	28.7	2.0
Predorsal distance	15	42.5-50.4	47.3	2.0
Preventral distance	15	40.2-47.4	44.4	1.8
Pelvic to anal-fin distance	15	14.6-21.3	18.1	1.5
Caudal peduncle depth	15	9.6-11.3	10.3	0.5
Dorsal-fin base	15	9.6-13.9	12.1	1.3
Anal-fin base	15	23.1-32.7	29.0	2.1
Pectoral-fin length	15	16.7-24.9	20.7	2.0
Pelvic-fin lengh	15	12.9-18.8	16.7	1.6
Dorsal-fin length	15	26.1-29.2	27.8	1.3
Anal-fin length	15	16.2-22.0	19.1	2.3
Caudal peduncle length	15	9.5-12.5	10.8	0.7
Dorsal to adipose-fin distance	15	31.7-38.2	34.9	2.0
Orbital to dorsal-fin distance	15	29.4-34.7	31.7	1.6
Dorsal to caudal peduncle distance	15	47.0-54.5	50.2	2.2
Head length	15	22.8-28.0	25.8	1.4
Percents of head length				
Orbital diameter	15	39.6-46.6	42.3	1.9
Snout length	15	14.1-20.7	16.7	1.8
Interorbital width	15	31.4-40.4	35.9	2.0
Premaxillary ramus	15	19.2-29.1	24.6	1.8

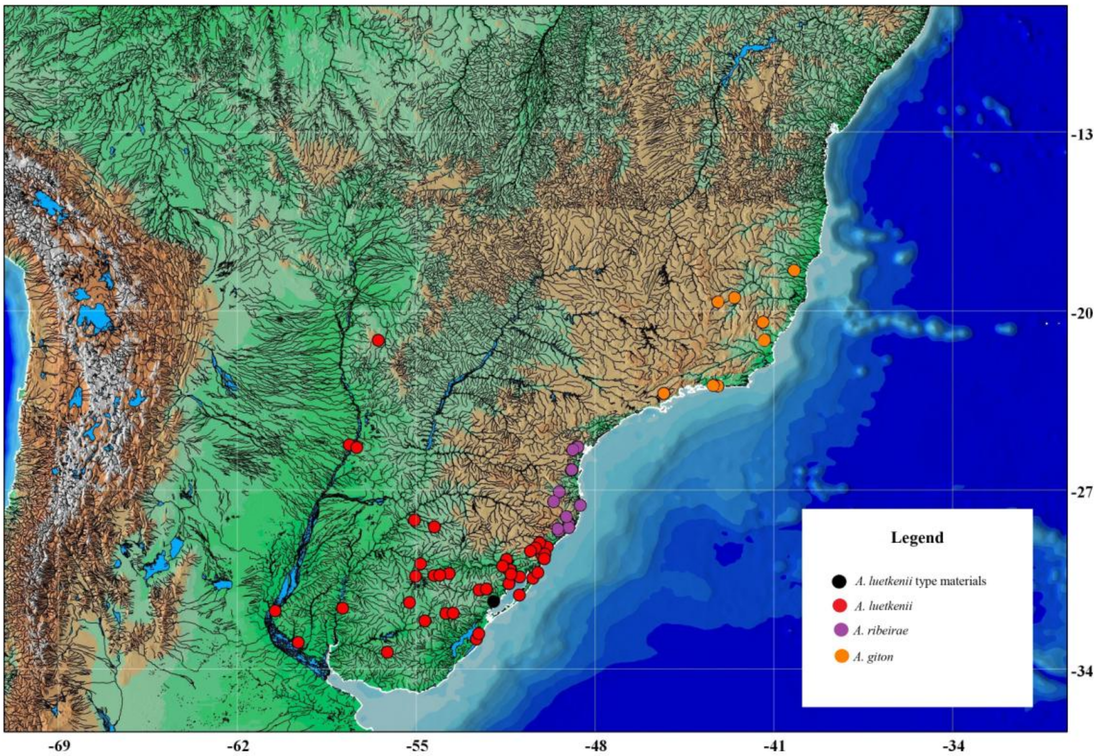

Fig. 1. Map showing the distribution of type material of *A*styanax *luetkenii* in southern Brazil, Uruguay and Paraguay, and other species of *Astyanax* in coastal drainages of southeast Brazil.

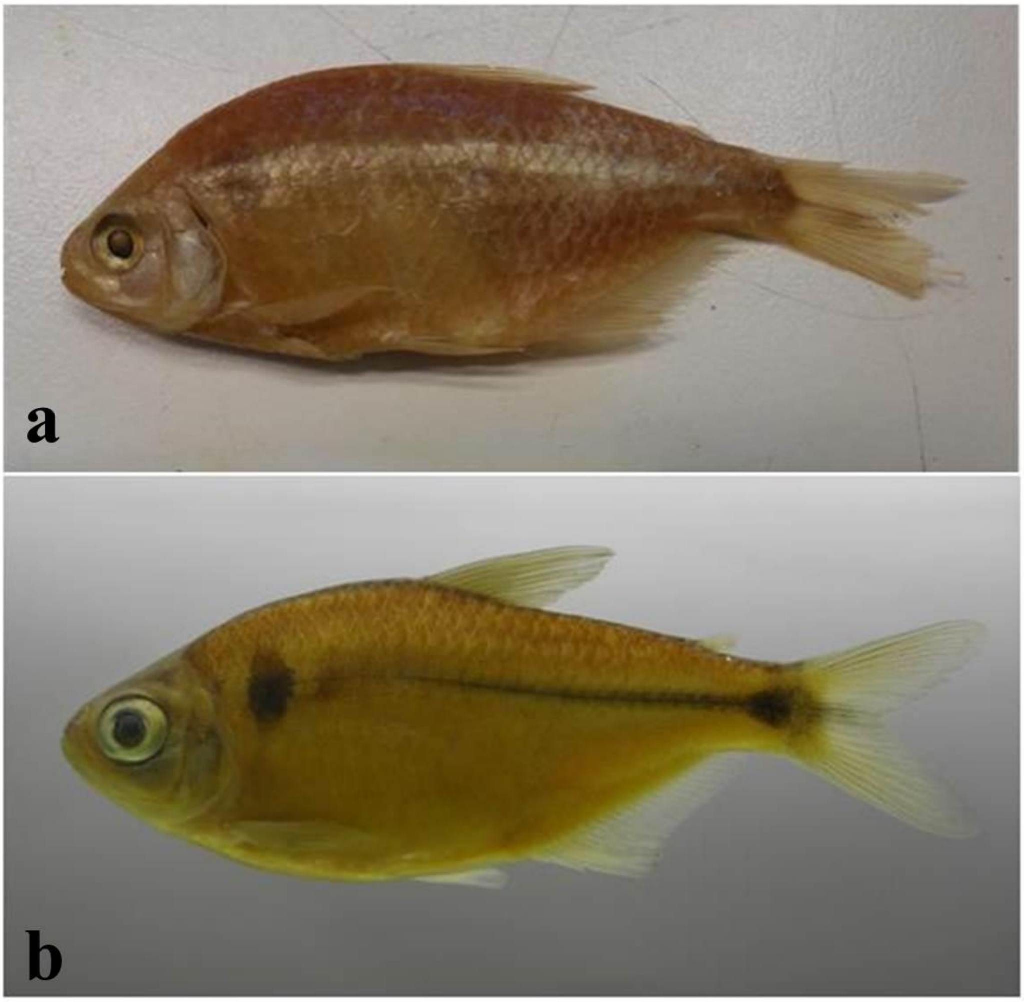

Fig. 2. *Astyanax luetkenii*, **a.** BMNH 1886.3.15.35, lectotype, 55.8 mm SL, San Lorenzo, Rio Grande do Sul, Brazil; **b.** UFRGS 5270, 44.8 mm SL, lagoa do Palácio,Viamão, Rio Grande do Sul, Brazil.

Fig. 3. *Astyanax riberae,* UFRGS 12549, 43.5 mm SL, rio Jordão, Santa Catarina, Brazil.

Fig. 4. *Astyanax giton*, UFRGS 14814, 75.1 mm SL, córrego Latão, tributaty of rio Doce, Coimbra, Minas Gerais, Brazil.

Fig. 5. *Astyanax hastatus*, UFRGS 10257, 51.1 mm SL, Macacu, Rio de Janeiro, Brazil.

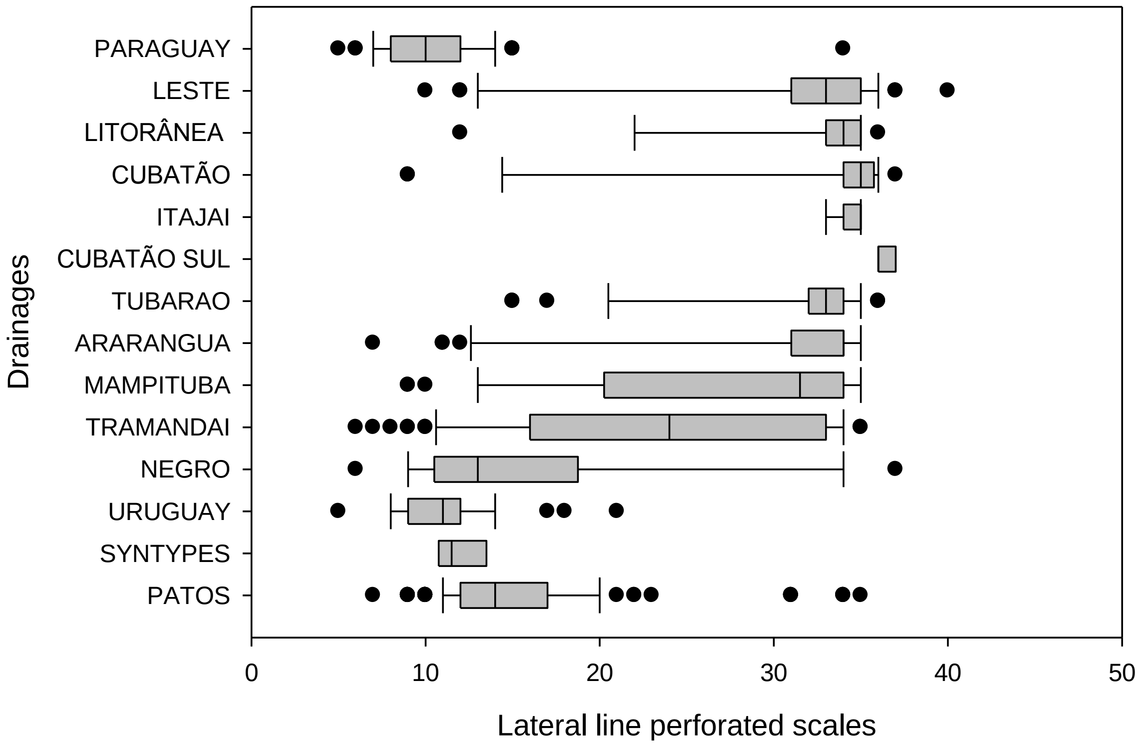

Fig. 6. Tukey box plots of number of perforated scales on lateral line in "*Astyanax*. *luetkenii*" populations by river drainage from South to North. Mean represented by thick vertical bar and 25th and 75th percetiles as lateral borders of box plots (*A. luetkenii*: Patos = 139, Syntypes = 6, Uruguay = 40, Negro = 30, Tramandaí = 75, Mampituba = 40, Paraguay = 68; *A. ribeirae*: Araranguá = 45, Tubarão = 39, Cubatão Sul = 8, Itajaí = 15, Cubatão = 30, Litorânea = 20; *A. giton*: Leste = 39).

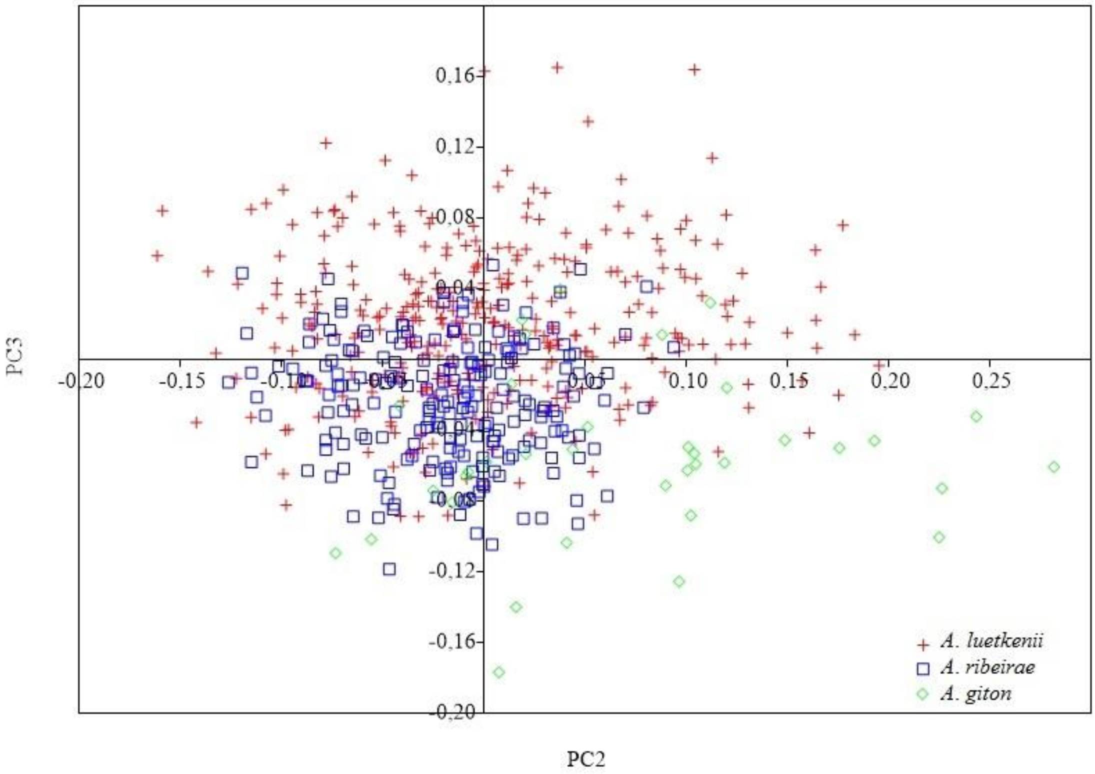

Fig. 7. Projection of individual scores in the space of second and third Principal Component axis for *Astyanax*: *A. luetkenii* (n = 339, laguna do Patos, type material, rio Uruguay, rio Negro, rio Tramandaí, rio Mampituba and rio Paraguay systems); *A. ribeirae* (n = 212, rio Tramandaí, rio Mampituba, rio Araranguá, rio Tubarão, Cubatão Sul, rio Itajaí, rio Cubatão and Litorânea systems); *A. giton* (n = 46, Leste system).

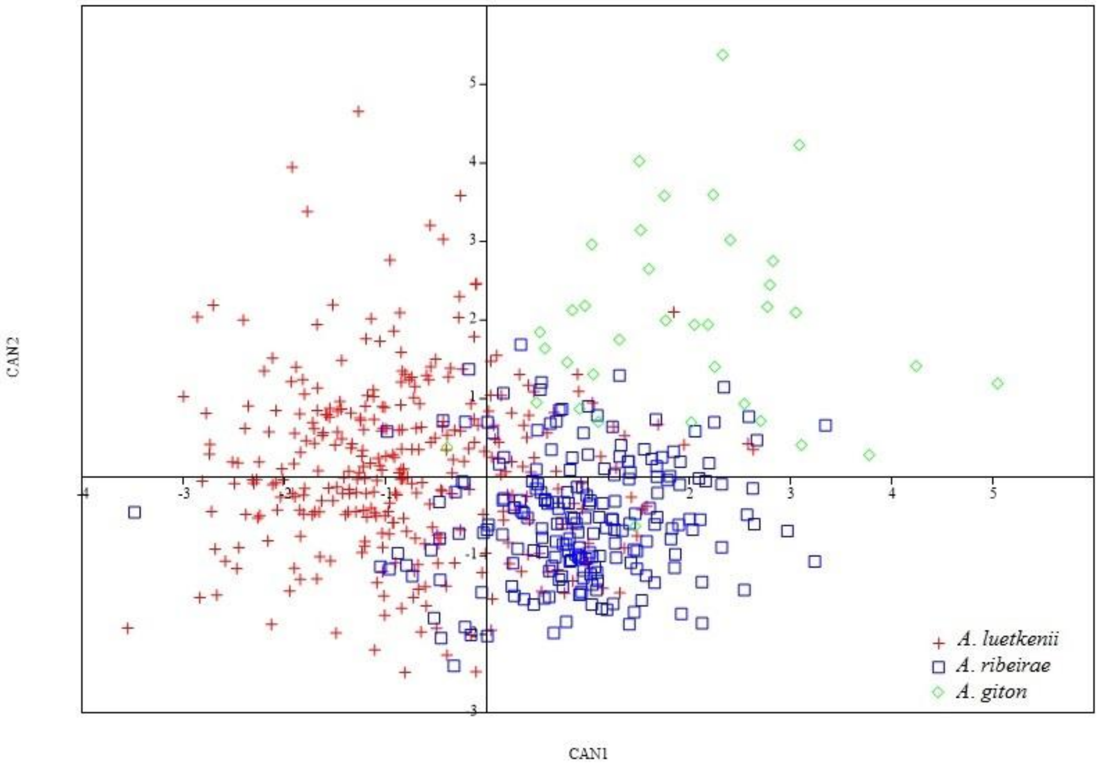

Fig. 8. Dispersion scores of combined individual samples *Astyanax* species in the first and second canonical axes: *A. luetkenii* (n = 339, laguna do Patos, type material, rio Uruguay, rio Negro, rio Tramandaí, rio Mampituba and rio Paraguay systems); *A. ribeirae* (n = 212, rio Tramandaí, rio Mampituba, rio Araranguá, rio Tubarão, Cubatão Sul, rio Itajaí, rio Cubatão and Litorânea systems); *A. giton* (n = 46, Leste system).

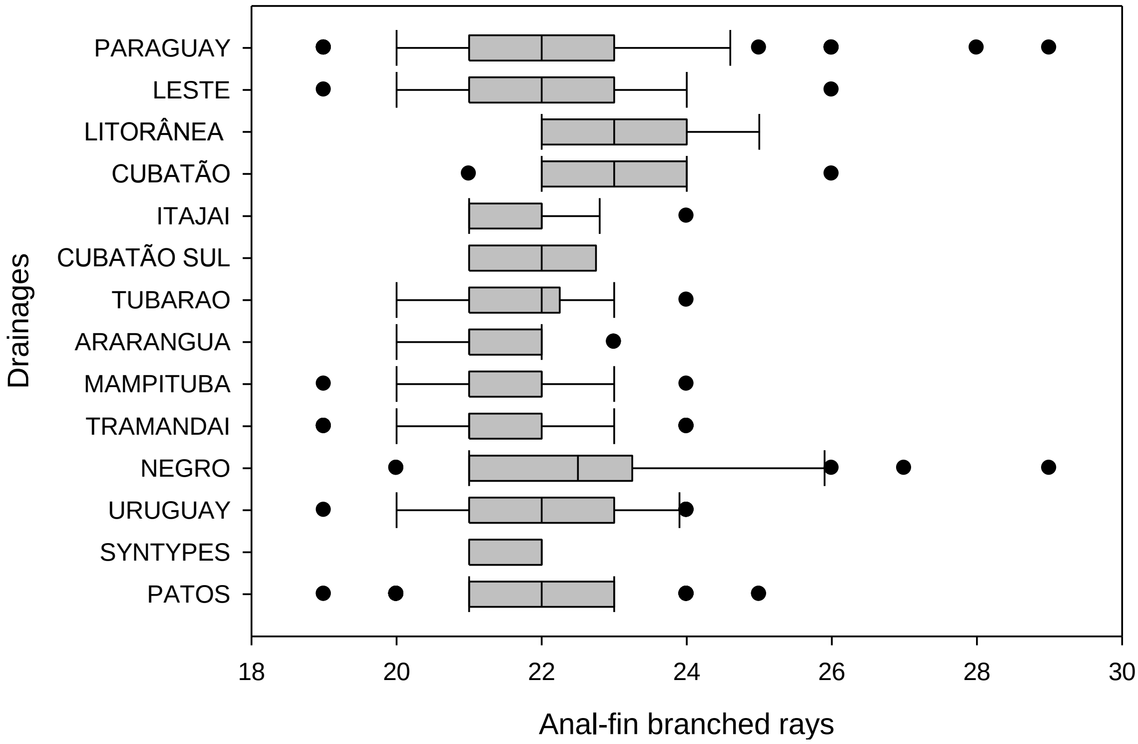

Fig. 9. Tukey box plots of number of branched anal-fin rays in *Astyanax* species by river drainages from South to North. Mean represented by thick vertical bar, and 25th and 75th percetiles as lateral borders of box plots (*A. luetkenii*: Patos = 139, Syntypes = 6, Uruguay = 40, Negro = 30, Tramandaí = 75, Mampituba = 40, Paraguay = 68; *A. ribeirae*: Araranguá = 45, Tubarão = 39, Cubatão Sul = 8, Itajaí = 15, Cubatão = 30, Litorânea = 20; *A. giton*: Leste = 39).

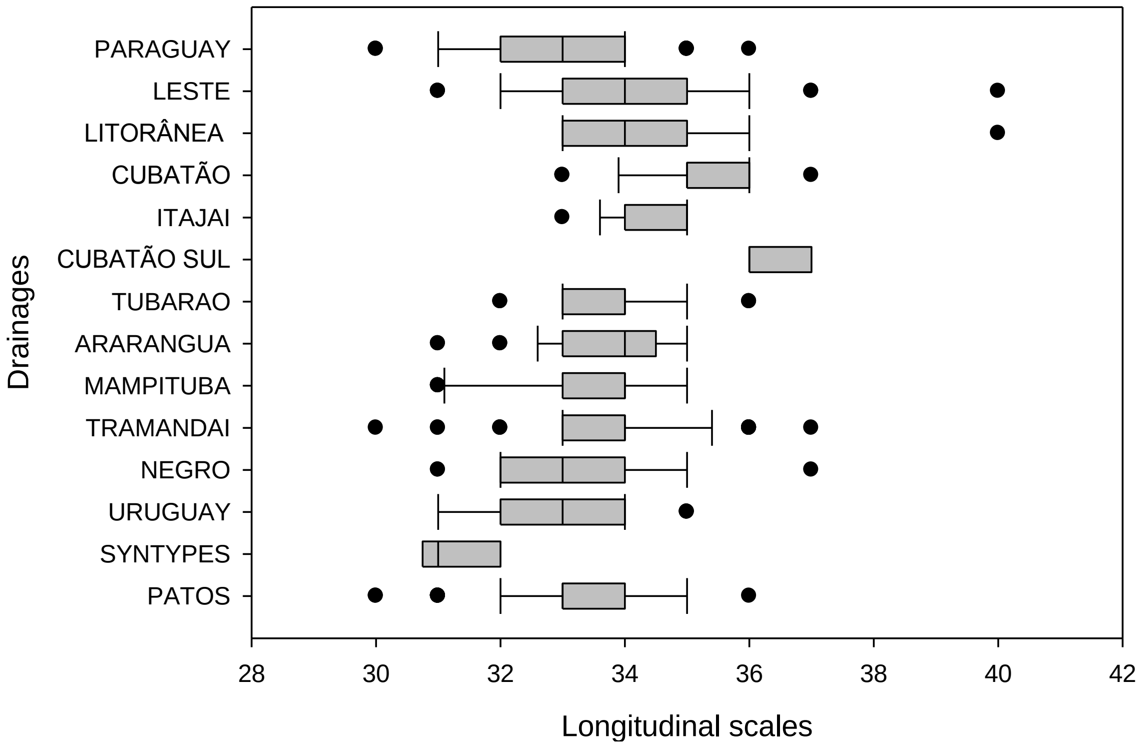

Fig. 10. Tukey box plots of number of longitudinal scales in *Astyanax*. species by river drainages from South to North. Mean represented by vertical bar, and 25th and 75th percetiles as lateral borders of box plots (*A. luetkenii*: Patos = 139, Syntypes = 6, Uruguay = 40, Negro = 30, Tramandaí = 75, Mampituba = 40, Paraguay = 68; *A. ribeirae*: Araranguá = 45, Tubarão = 39, Cubatão Sul = 8, Itajaí = 15, Cubatão = 30, Litorânea = 20; *A. giton*: Leste = 39).

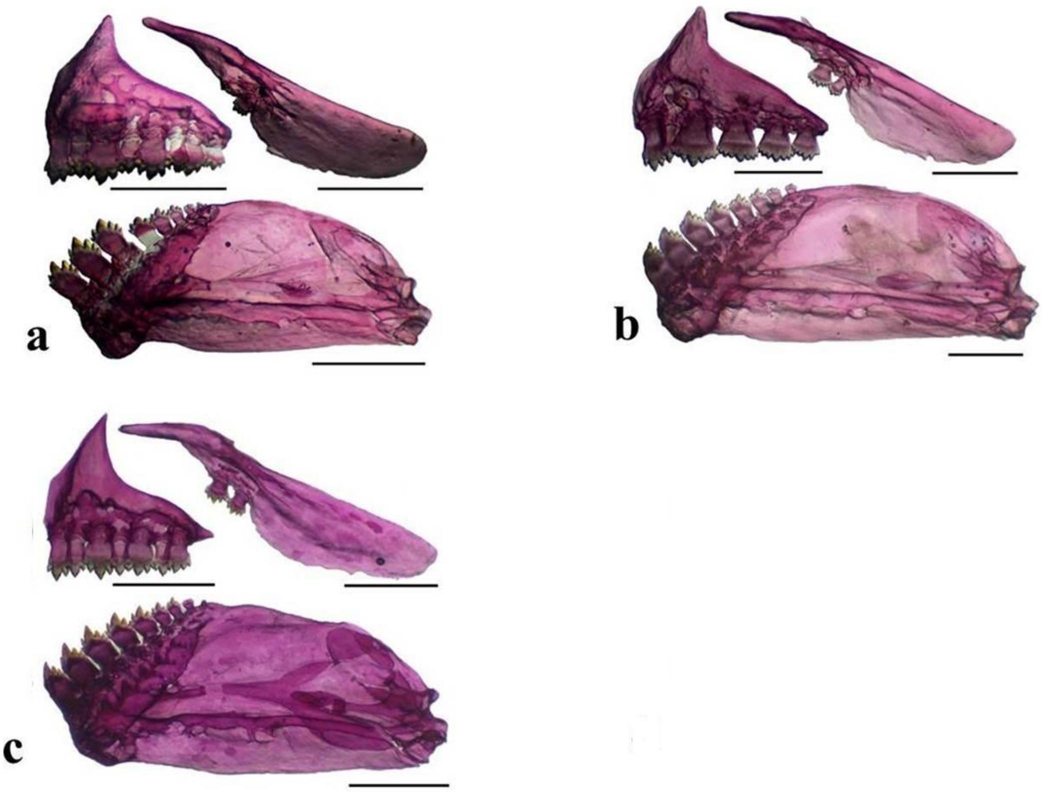

Fig. 11. *Astyanax luetkenii*, right premaxilla, maxilla and lower jaw in medial view: **a.** UFRGS 5610, 39.0 mm SL, arroio Ribeiro, Barra do Ribeiro, Brazil, laguna dos Patos system; **b.** UFRGS 7434, 50.9 mm SL, arroyo Maestre de Campo, Uruguay, rio Negro system; **c.** UFRGS 13293, 36.3 mm SL, Torres, Brazil, rio Mampituba system; Scale bar = 1 mm.

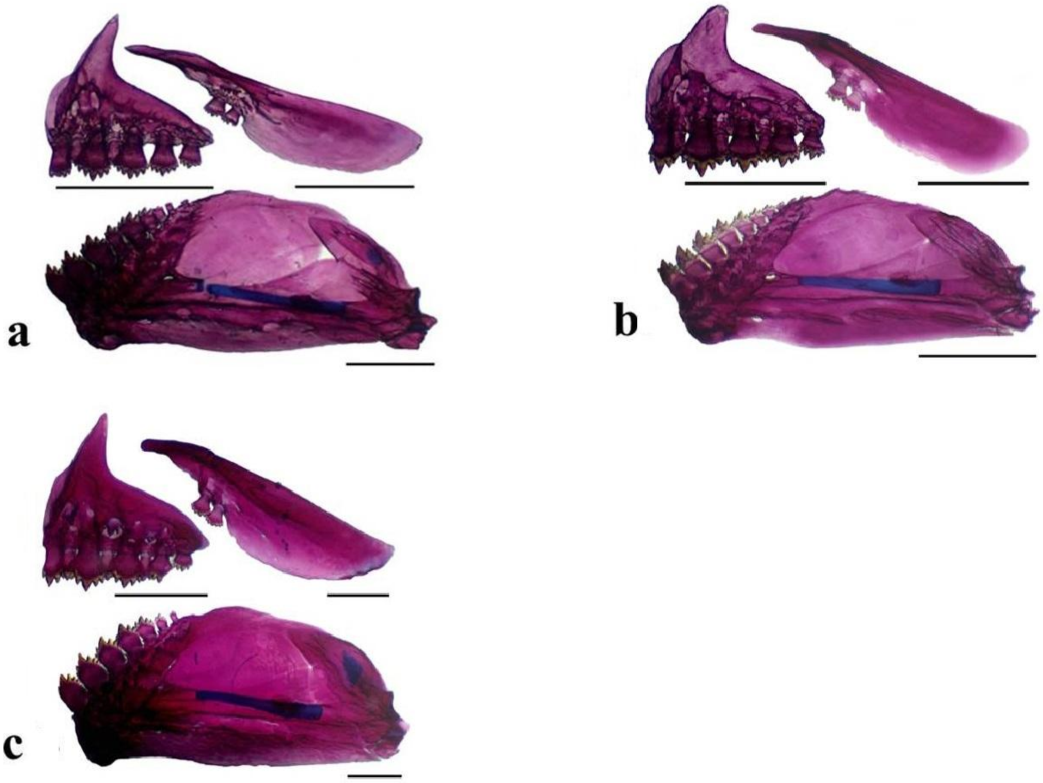

Fig. 12. *Astyanax ribeirae*, right premaxilla, maxilla and lower jaw in medial view: **a.** UFRGS 2206, 36.3 mm SL, rio Maquiné, Osório, Brazil, rio Tramandaí system; **b.** MCP 15397, 36.6 mm SL, rio Côrrea, Tubarão, Brazil, rio Tubarão system; **c.** MCP 22308, 37.5 mm SL, rio Antinhas, Brazil, rio Itajaí system. Scale bar = 1 mm.

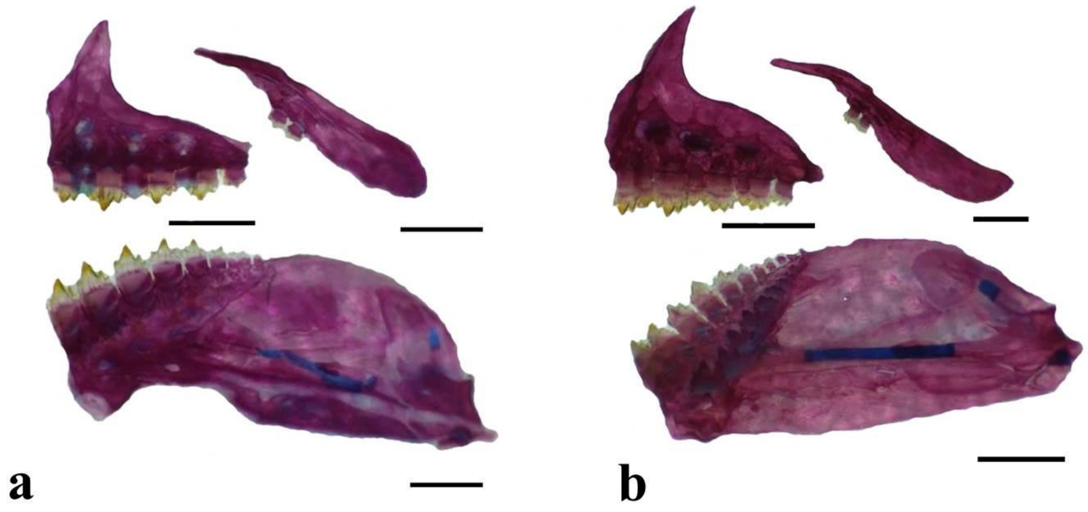

Fig. 13. Right premaxilla, maxilla and lower jaw in medial view: **a.** *Astyanax giton*, UFRGS 14814, 47.9 mm SL, córrego Latão, Coimbra, rio Doce system; **b.** *A*. *hastatus*, UFRGS 10257, 49.9 mm SL, distrito de Ypiranga, Macacu. Scale bar = 1 mm.

Conclusões gerais

Foram testadas na presente análise as relações filogenéticas entre *Hyphessobrycon luetkenii* (Boulenger, 1887), *Astyanax giton* Eigenmann, 1908, *A. hastatus* Myers, 1928, *A. intermedius* (Eigenmann, 1908), *A. janeiroensis* Eigenmann 1908, *A. jenynsii* (Steindachner, 1877), *A. parahybae* (Eigenmann, 1908), *A. ribeirae* Eigenmann, 1911, *A. taeniatus* (Jenyns, 1842), e as sete espécies de *Deuterodon* Eigenmann, baseados nas publicações de definição para o gênero de Lucena & Lucena (1992, 2002): *D. iguape* Eigenmann, 1907, *D. langei* Travassos, 1957, *D. longirostris* (Steindachner, 1907), *D. rosae* (Steindachner, 1908), *D. singularis* Lucena & Lucena, 1992, *D. stigmaturus* (Gomes, 1947) e *D. supparis* Lucena & Lucena, 1992.

A maioria dessas espécies (*H. luetkenii*, *A. ribeirae*, *A. giton*, *A. hastatus*, *A. taeniatus* e *Deuterodon*) compartilham entre si um padrão similar de forma de mancha umeral e dentição do dentário, embora, estas espécies estejam alocadas em gêneros diferentes.

De acordo com a sistemática clássica da família Characidae (Eigenmann, 1917), *Hyphessobrycon* Durbin difere de *Astyanax* Baird & Girard por apresentar a linha lateral interrompida. Malabarba (1998) ao estabelecer o monofiletismo de Cheirodontinae, comentou sobre os estados desse caráter, que é, provavelmente, o mais comum usado por Eigenmann ao reconhecer vários gêneros de família. Em sua análise, a inclusão da linha lateral completa ou interrompida, é responsável por uma redução do índice de consistência e um aumento do comprimento da árvore, mesmo em uma pequena linhagem de Characidae, o tipo de linha lateral é altamente homoplástica e não informativa quanto às relações de espécies.

Mais recentemente, Carvalho (2011) estabeleceu as espécies *Hyphessobrycon stricto sensu*, onde *H. luetkenii*, embora apresente a linha lateral interrompida, não foi agrupado neste clado. Entre as espécies dos gêneros testados aqui, *Deuterodon*, é o único gênero que apresenta estudos anteriores indicando sua monofilia (Lucena & Lucena, 1992, 2002; Pereira, 2010), baseados em três sinapomorfias relacionadas com as mandíbulas: margem ventral da porção com dentes do maxilar divergindo da margem dorsal em sentido anterior; margem ventral com dentes do maxilar arqueando-se em direção à margem ventral do pré-maxilar, de modo a formarem um eixo contínuo; região posterior edêntula do maxilar curta, seu comprimento, no máximo, duas vezes o comprimento da região com dentes desse osso. Além disso, *Deuterodon* diferencia-se dos demais caraciformes pelo seguinte conjunto de caracteres: duas fileiras de dentes no pré-maxilar, a interna com cinco dentes e a externa com 1 a 3 dentes; dentes, exceto os da fileira externa do pré-maxilar e os dois primeiros do dentário, espalmados e comprimidos anteroposteriormente; 6 a 7 cúspides nos dentes da fileira interna do pré-maxilar, maxilar e dentário dispostas no mesmo plano; 3 a 7 dentes no maxilar; dentes do dentário decrescendo gradualmente; porções laterais do lábio superior atrofiadas na maioria das espécies; ausência de escamas sobre as nadadeiras e linha lateral completa.

Como reslutado da presente reconstrução filogenética, a árvore de consenso gerada pelo método de “pesos implícitos” analisados pelo software TNT, com 240 táxons e 365 caracteres (2702 passos; IC = 14; RI = 65) (Mirande, 2009, 2010; Carvalho, 2011), resultou em um clado monofilético que abriga todas as espécies aqui testadas (exceto *A. janeiroensis*) e, corrobora com estudos anteriores que apontavam uma estreita possível relação entre esses táxons com um padrão similar de dentes dentário (Travassos, 1957; Lucena & Lucena, 1992, 2002; Melo, 2001). Embora, estes grupos estejam intimamente relacionados entre si, a diminuição gradual no tamanho dos dentes mandibulares (Char. 148), é altamente homoplástico (23 passos) e apresenta um baixo índice de consistência (ci = 4), não sendo um caráter decisivo para o agrupamento destas espécies.

Entre os resultados dessa análise, *Deuterodon* provou ser um grupo monofilético, sendo reconhecido como grupo irmão de *H. luetkenii* e *A. ribeirae,* que ficaram proximamente relacionados entre si, juntamente com as espécies de *Astyanax* das bacias costeiras do leste, essas, no entanto, ficaram reunidas em uma grande politomia (isso pode ser explicado em parte, pelo baixo número de caracteres codificados na matriz e em parte por fatores biogeográficos). Os caráteres de *A. hastatus, A. parahybae, A. jenynsii* e *A. janeiroensis* foram codificados com base nos dados observados dos materiais tipo examinado, uma vez que o reconhecimento das espécies não é totalmente claro e muitos dados, merísticos e morfométricos apresentam uma grande sobreposição. Assim sendo, a principal modificação taxonômica resultante dessa análise é a transferência de *Hyphessobrycon luetkenii* para o gênero *Astyanax*, que configura melhor o atual estado de conhecimento de relações com as outras espécies.

A partir da nova combinação taxonômica, *Astyanax luetkenii* é redescrita baseado no material tipo e em novo material coletado do sistema da laguna do Patos, Rio Grande do Sul, Brasil. A espécie é diagnosticada pela presença de linha lateral incompleta ou interrompida, com 9-18 escamas perfuradas, dentes na série interna do pré-maxilar com seis a sete cúspides, nadadeira anal com iii-v, 20-24 raios e pela presença de uma mancha umeral verticalmente alongada e relativamente arredondada com uma extensão estreita ventralmente, conferindo um formato geral de vírgula. Após análises morfométricas e merísticas a distribuição da espécie passa a ser restrita para os sistemas da laguna dos Patos, rio Uruguai, rio Negro, rio Paraguai, rio Tramandaí e rio Mampituba. Nos sistemas dos rios Tramandaí e Mampituba, os espécimes examinados apresentam dois padrões diferentes relacionado as escamas perfurradas da linha lateral, portanto, para estas drenagens são reconhecidas duas espécies: *A. luetkenii* (linha lateral interrompida ou incompleta) e *A. ribeirae* (linha lateral completa). Estas bacias hidrográfica representam o limite mais meriodional da distibuição de *A. luetkenii*, e o limite mais setentrional da distribuição de *A. ribeirae* (rio Tramandaí, RS - rio Ribeira do Iguape, SP), quanto aos registros previamente identificados como pertencentes a *A. luetkenii*, ao norte da bacia do rio Ribeira do Iguape, nos sistemas costeiros do leste do Brasil, são agora reconhecidos como *A. giton*.

A atual distribuição de *A. luetkenii* e o reconhecimento de *A. ribeirae* e *A. giton* em toda a faixa de distribuição previamente conhecida para *A. luetkenii*, corrobora com estudos anteriores sobre a distribuição e endemismo de outros grupos de Characidae (Menezes, 1988; Vari, 1988; Bizerril, 1994).

Vari (1988) reconheceu duas regiões de endemismo ao sul da bacia amazônica de distribuição das populações de Curimatidae na região Neotropical: (1) o sistema do alto rio Paraná e, (2) o sistema dos rios Paraguai, baixo rio Paraná, Uruguai, sistema da laguna dos Patos e pequenos rios costeiros do sudeste do Brasil (Rio Grande do sul e sul do Estado de São Paulo). *Astyanax luetkenii* corrobora parcialmente com os padrões de distribuição definidos para Curimatidae quanto a segunda região de endemismo, no que se refere aos sistemas da laguna do Patos, rio Uruguai e rio Paraguai. Menezes (1988), reconheceu três áreas endêmicas de distribuição de espécies costeiras de *Oligosarcus* Günther: (1) Sub-região Litoral Sul (laguna dos Patos), (2) Sub-região costeira Central (extremo sul da Serra do Mar até o Cabo de Santa Marta), e (3) Sub-região costeira Norte. *Astyanax luetkenii* é encontrada na sub-região Litoral Sul, enquanto *A. ribeirae* e *A. giton* se encontram sub-região do costeira Central e Sub-região costeira Norte, respectivamente, o que corrobora a hipótese de que vários grupos de Characidae tiveram um processo vicariante e especiação semelhante entre o leste do litoral brasileiro. Bizerril (1994), com base na composição taxonômica da ictiofauna do leste, reconhece dois subprovíncias: a) subprovíncia costa sudeste (ao sul por Santa

Catarina e ao norte pelo planalto do Rio de Janeiro), e b) subprovíncia costa leste (do norte do Rio de Janeiro até a foz do rio São Francisco). Em ambos os trabalhos, embora os limites e número das sub-regiões ou subprovíncias apresentem uma certa variação conforme o autor, o padrão de distribuição para as espécies nominadas neste presente trabalhos são bastante semelhantes.

Este estudo demonstrou a monofilia de um grupo de espécies que compartilham entre si caráteres relacionados a dentição e forma da mancha umeral como monofilético, no entanto, demonstrou a necessidade de mais estudos taxonômicos com as espécies de *Astyanax* do sistema de rios costeiros do leste, para que futuramente, se possa melhor determinar as relações de parentesco entre essas espécies.

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