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A new *Hyphessobrycon* (Ostariophysi: Characiformes: Characidae) from the middle Amazon basin, Brazil

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Abstract

Hyphessobrycon montagi, new species, is described from tributaries of the Rio Arapiuns, a left margin affluent of the lower Rio Tapajós, Amazon basin, Pará, Brazil. The new species can be diagnosed from all its congeners by the possession of a combination of two well-defined humeral blotches, connected by a narrow stripe, and a caudal peduncle blotch. A putatively monophyletic *Hyphessobrycon heterorhabdus* species-group, restricted to *H. heterorhabdus*, *H. amapaensis*, and *H. eschwartze*, is herein proposed based on shared derived features of color pattern. Alternative proposals of a “*Hyphessobrycon heterorhabdus* group” presented in the recent literature are evaluated and criticized.

Key words: *Hyphessobrycon heterorhabdus*, Rio Arapiuns, Rio Tapajós, terra firme, species groups

Resumo

Hyphessobrycon montagi, nova espécie, é descrita de tributários do rio Arapiuns, um afluente de margem esquerda do rio Tapajós, bacia amazônica, Pará, Brasil. A nova espécie pode ser diagnosticada de todos os seus congêneres por possuir uma combinação de duas manchas umerais bem definidas, conectadas por uma listra estreita e uma mancha escura no pedúnculo caudal. Um presumivelmente monofilético grupo de espécies *Hyphessobrycon heterorhabdus*, restrito a *H. heterorhabdus*, *H. amapaensis* e *H. eschwartze* é proposto aqui baseado em caracteres derivados de padrão de colorido. Propostas alternativas recentes de um “grupo *Hyphessobrycon heterorhabdus*” apresentados na literatura são avaliadas e criticadas.

Palavras-chave: *Hyphessobrycon heterorhabdus*, Rio Arapiuns, Rio Tapajós, terra firme, grupos de espécies

Introduction

The genus *Hyphessobrycon* is one of the most speciose genera in the family Characidae, comprising 136 species currently recognized as valid (Lima *et al.*, 2003; Teixeira *et al.*, 2014; Zarske, 2014; Dagosta *et al.*, 2014). The genus has been long recognized as being probably not monophyletic (e.g., Weitzman & Fink, 1983; Weitzman & Palmer, 1997), a hypothesis that has been supported by both molecular (Javonillo *et al.*, 2010) and morphological (Mirande, 2010) phylogenetic studies of the family Characidae. In addition, the alpha-taxonomy of most species included in *Hyphessobrycon* and related genera is still poorly understood.

Intensive fish collecting at Juruti, a locality situated at the right bank of the Rio Amazonas, a little above the rio Tapajós mouth, has been conducted since 2004 by the third author and associates within a large biological inventory as part of the environmental studies aiming to evaluate the impact of a large bauxite-ore mining operation which was implanted in the area. During the course of this survey, fish sampling was conducted at the streams and rivers draining the low-lying plateaus into the Rio Arapiuns basin, a left-margin tributary of the lower

rio Tapajós, and resulted in the discovery of some fish species (Rodriguez & Reis, 2007; Lima *et al.*, 2009; Peixoto & Wosiacki, 2013). The by-far most abundant fish species occurring at the terra firme streams in the Juruti area is an attractively-colored *Hyphessobrycon* species, characterized by the presence of two well-defined humeral blotches and a caudal-fin blotch, which, somewhat surprisingly given its local abundance, was previously unknown to science. The aim of the present contribution is to describe this distinctive, yet undescribed, *Hyphessobrycon* species.

Material and methods

Counts and measurements were taken according to Fink & Weitzman (1974) and Menezes & Weitzman (1990), except for counts of the horizontal scale rows below the lateral line, that were counted to the pelvic-fin insertion. Horizontal scale rows between dorsal-fin origin and lateral line does not include the scale of median predorsal series situated just anterior to first dorsal-fin ray. In the description, the frequency of each count is given in parentheses after the respective count, and are followed by their frequency in parentheses (an asterisk indicates the count of the holotype). In the list of analyzed material, total number of specimens of each lot is giving first, followed by those cleared and stained (CS), if any.

Counts of supraneurals, vertebrae, procurent caudal-fin rays, unbranched dorsal and anal fin rays, branchiostegal rays, gill-rakers, maxillary, and dentary teeth were taken only from cleared and stained paratypes, prepared according to Taylor & Van Dyke (1985). Vertebrae of the Weberian apparatus were counted as four elements and included in the vertebral counts, and the fused PU1+U1 of the caudal region as a single element. Patterns of scale *circuli* and *radii* were described from scales sampled from the area between lateral-line and dorsal-fin origin. Jaw bones were cleaned from soft tissues for SEM images by a short (less than 10 minutes) immersion in diluted chlorine solution and after that air-dried. Physico-chemical parameters from sampled streams were obtained using multiparameter equipment (JDC instruments and Lutron). Institutional abbreviations are: ANSP (Academy of Natural Sciences of Philadelphia, Philadelphia), INPA (Instituto Nacional de Pesquisas da Amazônia, Manaus), MCP (Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre), MPEG (Museu Paraense Emílio Goeldi, Belém), MZUSP (Museu de Zoologia da Universidade de São Paulo, São Paulo), USNM (National Museum of Natural History, Smithsonian Institution, Washington), and ZUEC (Museu de Zoologia da Universidade Estadual de Campinas, Campinas).

Hyphessobrycon montagi, new species

Figures 1–2

Holotype. MPEG 29970, 1, 31.1 mm SL, Brazil, Pará, Juruti, Igarapé Socó Barroso (trib. rio Arapiuns), 2°27'54"S, 56°0'25"W, L.F.A. Montag, 3 April 2006.

Paratypes. All from Brazil, Pará, Juruti. MPEG 10340, 36, 17.7–27.9 mm SL, same data as holotype. Following lots from Igarapé Socó Barroso (trib. rio Arapiuns), 2°27'54"S, 56°0'25"W: MPEG 14730, 24, 11.3–22.4 mm SL, W.B. Wosiacki, 21 Feb 2008; MPEG 14735, 193, 11.4–25.9 mm SL, W.B. Wosiacki, 1 Dec 2007; MPEG 24852, 7, 20.5–25.7 mm SL, W.B. Wosiacki, 21 Feb 2008; MPEG 13860, 21, 18.1–25.9 mm SL, W.B. Wosiacki, 16 May 2007; MPEG 26055, 48, 10.8–27.7 mm SL; MPEG 26053, 108, 10.4–25.7 mm SL, M. Mendonça, 5 Dec 2012. Following lots from Igarapé Mutum (trib. rio Aruã, trib. rio Branco, trib. rio Arapiuns), 2°36'44.8"S, 56°11'37.3"W: MPEG 10449, 80, 13.1–26.5 mm SL, W.B. Wosiacki, 8 Sept 2002; MPEG 10344, 43, 17.2–30.8 mm SL; ZUEC 8319, 20, 20.6–28.8 mm SL, W.B. Wosiacki & A. Bezerra, 6 Aug 2004; MPEG 24846, 11, 15.8–27.0 mm SL, W.B. Wosiacki, 19 Feb 2008; MPEG 24865, 28, 17.6–26.6 mm SL; MPEG 24841, 12, 9.0–25.7 mm SL; R. Raiol, 19–20 Nov 2010; MPEG 14734, 333, 9.5–28.0 mm SL, A. Hercos, 27 Nov 2007; MPEG 10336, 15, 18.6–30.4 mm SL; ZUEC 8318, 10, 21.4–27.9 mm SL, L.F.A. Montag, 3 March 2006; MPEG 10458, 4, 12.4–25.5 mm SL, W.B. Wosiacki & A.S. Bezerra, 2 Aug 2004; MPEG 24858, 89, 14.6–27.4 mm SL, W.B. Wosiacki, 3 Jun 2010; MPEG 24830, 17, 8.5–22.4 mm SL, R. Raiol, 4 Dec 2008; MPEG 14740, 354, 12.3–28.2 mm SL; ANSP 197188, 10, 18.0–21.6 mm SL; INPA 45068, 20, 19.8–28.5 mm SL; MCP 48264, 10, 16.7–26.0 mm SL, A. Hercos, 27 Nov 2007; MPEG 24824, 147, 16.2–29.4 mm SL, W.B. Wosiacki, 19 Feb 2008;

MPEG 30361, 13, 13.3–27.1 mm SL, M.B. Mendonça, L.A.W. Peixoto & F.L. Felier, 06 Dec 2013. Following lots from Igarapé Rio Branco, trib. rio Arapiuns, 2°28'13.9"S, 56°0'12.3"W: MPEG 10464, 8, 16.2–24.0 mm SL, W.B. Wosiacki & A.S. Bezerra, 8 Aug 2004; MPEG 10342, 10, 19.7–29.4 mm SL, W.B. Wosiacki, 8 Aug 2004. Following lots from Igarapé Rio Branco, trib. rio Arapiuns, 2°20'57.9"S, 56°1'22.5"W: MPEG 10470, 26, 15.8–25.5 mm SL, W.B. Wosiacki & A.S. Bezerra, 9 Aug 2004; MPEG 26056, 54, 17.7–25.0 mm SL, M. Mendonça, 27 Nov 2012; MPEG 24869, 83, 10.6–26.3 mm SL, W.B. Wosiacki, 27 Nov 2010; MPEG 24863, 4, 19.6–23.8 mm SL, R. Raiol, 6 June 2010; MPEG 24840, 24, 10.7–27.2 mm SL, R. Raiol, 18 Sept 2009. Following lots from Igarapé São Francisco (trib. rio Arapiuns), 2°34'51.5"S, 55°54'14.5"W: MPEG 7914, 92, 13.3–29.1 mm SL; MZUSP 115389, 10, 21.3–26.5 mm SL, W.B. Wosiacki, 12 Aug 2004; MPEG 24857, 6, 18.2–26.6 mm SL, MPEG 24859, 6, 17.2–28.1 mm SL, R. Raiol, 4 June 2010; MPEG 24839, 31, 13.6–27.2 mm SL, R. Raiol, 24 Sept 2009.

Not types. All from Brazil, Pará, Juruti: Following lots from Igarapé Socó Barroso (trib. rio Arapiuns), 2°27'54"S, 56°0'25"W: MPEG 12884, 59, 10.3–26.4 mm SL; MPEG 12873, 30, 10.3–18.1 mm SL; MPEG 12890, 16, 17.9–26.8 mm SL; MPEG 12877, 51, 10.2–26.2 mm SL; MPEG 12876, 144, 9.2–26.4 mm SL, L.F.A. Montag, 12–13 Dec 2006. MPEG 10455, 14, 14.0–18.4 mm SL, L.F.A. Montag, 4 Mar 2006; MPEG 11050, 30, 11.3–22.2 mm SL; MPEG 11041, 1, 13.3 mm SL; MPEG 11052, 17, 15.1–24.4 mm SL; MPEG 11049, 22, 15.0–25.3 mm SL, A. Hercos, 18–19 Aug 2006; MPEG 12978, 15, 12.2–24.1 mm SL, L.F.A. Montag, 19 Aug 2006; MPEG 10338, 136, 17.1–25.5 mm SL; 10, 20.1–27.9, CS, L.F.A. Montag, 4 Mar 2006; MPEG 24829, 1, 19.3 mm SL, W.B. Wosiacki, 20 Feb 2008; MPEG 24860, 16, 14.7–23.3 mm SL, R. Raiol, 05 Jun 2010; MPEG 24844, 34, 13.7–25.8 mm SL, R. Raiol, 23 Sep 2009; MPEG 24851, 5, 10.6–22.6 mm SL, W.B. Wosiacki, 21 Feb 2008; MPEG 24838, 119, 15.7–17.1 mm SL, R. Raiol, 11 Dec 2008; MPEG 24850, 6, 17.021.5 mm SL, W.B. Wosiacki, 21 Feb 2008; MPEG 24861, 6, 15.0–23.5 mm SL, R. Raiol, 5 June 2010; MPEG 24867, 18, 17.4–27.2 mm SL, R. Raiol, 21 Nov 2010; MPEG 24843, 40, 10.3–25.4 mm SL, R. Raiol, 23 Sep 2009; MPEG 13796, 12, 18.1–23.2 mm SL, W.B. Wosiacki, 16 May 2007. Following lots from Igarapé Mutum (trib. rio Aruã, trib. rio Branco, trib. rio Arapiuns), 2°36'44.8"S, 56°11'37.3"W: MPEG 10459, 23, 11.6–22.7 mm SL, W.B. Wosiacki, 9 Sept 2002; MPEG 10473, 1, 12.2 mm SL, W.B. Wosiacki, 6 Aug 2004; MPEG 14752, 29, 14.2–25.6 mm SL; MPEG 24848, 9, 20.9–22.8 mm SL; MPEG 24847, 9, 14.9–23.3 mm SL, W.B. Wosiacki, 19 Feb 2008; MPEG 12875, 150, 8.9–28.4 mm SL; MPEG 12881, 60, 9.7–27.8 mm SL; MPEG 13003, 12, 9.9–16.6 mm SL; MPEG 13005, 25, 9.4–15.9 mm SL; MPEG 12882, 1, 25.0 mm SL; MPEG 12977, 16, 11.4–16.5 mm SL, L.F.A. Montag, 11–12 Dec 2006; MPEG 10461, 15, 20.1–24.5 mm SL; MPEG 10460, 14, 19.5–25.1 mm SL; MPEG 10453, 49, 18.6–32.1 mm SL, L.F.A. Montag, 3 March 2006; MPEG 11048, 3, 18.1–20.9 mm SL; MPEG 11046, 3, 16.8–20.3 mm SL; MPEG 11044, 44, 17.5–28.9 mm SL; MPEG 11045, 13, 11.6–21.1 mm SL, A. Hercos, 17 Aug 2006; MPEG 11042, 5, 22.5–28.4 mm SL; MPEG 11054, 1, 15.0 mm SL; MPEG 10454, 8, 16.9–26.2 mm SL, A. Hercos, 3 March 2006; MPEG 14388, 13, 9.3–19.1 mm SL; MPEG 14360, 1, 26.1 mm SL; MPEG 14363, 2, 14.0–15.7 mm SL, A. Hercos, 27 Nov 2007; MPEG 24855, 7, 16.3–26.5 mm SL, R. Raiol, 3 June 2010; MPEG 24864, 1, 19.3 mm SL; MPEG 24866, 7, 17.8–22.8 mm SL, R. Raiol, 19 Nov 2010; MPEG 24831, 1, 16.1 mm SL, R. Raiol, 4 Dec 2008; MPEG 26054, 7, 13.6–24.6 mm SL, M. Mendonça, 28 Nov 2012; MPEG 24842, 19, 21.3–27.0 mm SL, R. Raiol, 20 Sep 2009; MPEG 24832, 88, 17.3–29.0 mm SL, R. Raiol, 04 Dec 2008; MPEG 26057, 31, 13.8–28.3 mm SL, M. Mendonça, 28 Nov 2012; Following lots from Igarapé Rio Branco, trib. rio Arapiuns, 2°20'57.9"S, 56°1'22.5"W: MPEG 10472, 21, 13.5–23.2 mm SL, W.B. Wosiacki & A.S. Bezerra, 11 Aug 2004; MPEG 10463, 6, 16.9–20.9 mm SL, W.B. Wosiacki & A. Bezerra, 14 Aug 2004; MPEG 10465, 2, 20.1–22.0 mm SL, W.B. Wosiacki, 12 Aug 2004; MPEG 10466, 7, 13.6–20.9 mm SL, W.B. Wosiacki & A.S. Bezerra, Aug 2004; MPEG 10469, 13, 11.1–19.2 mm SL, W.B. Wosiacki & A.S. Bezerra, 8 Aug 2004; MPEG 10456, 29, 14.1–20.0 mm SL, W.B. Wosiacki & A. Bezerra, 11 Aug 2004; MPEG 10462, 2, 14.2–19.2 mm SL, W.B. Wosiacki & A.S. Bezerra, 9 Aug 2004; MPEG 15090, 5, 18.3–23.0 mm SL, W.B. Wosiacki, 18 Feb 2008; MPEG 24833, 20, 13.3–23.7 mm SL, R. Raiol, 6 Dec 2008; MPEG 24834, 25, 18.0–24.3 mm SL, R. Raiol, 6 Dec 2008; MPEG 24862, 4, 20.4–26.0 mm SL, R. Raiol, 6 Jun 2010; MPEG 24854, 1, 22.5 mm SL, R. Raiol, 18 Sep 2009; MPEG 24870, 48, 17.3–25.5 mm SL, R. Raiol, 27 Nov 2010; MPEG 24823, 5, 21.8–24.6 mm SL, W.B. Wosiacki, 18 Feb 2008; MPEG 26508, 42, 16.2–21.0 mm SL, M. Mendonça, 27 Nov 2012. Following lots from Igarapé Rio Branco, trib. rio Arapiuns, 2°28'13.9"S, 56°0'12.3"W: MPEG 10467, 1, 19.3 mm SL, W.B. Wosiacki & A.S. Bezerra, 8 Aug 2006; MPEG 10471, 7, 16.0–24.1 mm SL, W.B. Wosiacki & A.S. Bezerra, 8 Aug 2004. Following lots from Igarapé São Francisco (trib. rio Arapiuns), 2°34'50.7"S, 55°54'14.5"W: MPEG 12880, 66, 12.2–21.7 mm SL, L.F.A. Montag, 15 Dec 2006;

MPEG 11057, 97, 10.7–26.3 mm SL; MPEG 11053, 133, 11.5–26.4 mm SL, A. Hercos, 19–20 Aug 2006; MPEG 12886, 78, 12.2–22.6 mm SL, W.B. Wosiacki, 14 Dec 2006; MPEG 13815, 5, 19.0–26.7 mm SL, W.B. Wosiacki, 15 May 2007; MPEG 13751, 17, 20.0–27.8 mm SL, W.B. Wosiacki, 15 May 2007; MPEG 24856, 4, 18.7–20.0 mm SL, R. Raiol, 4 June 2010; MPEG 24825, 9, 17.9–23.9 mm SL, W.B. Wosiacki, 20 Feb 2008; MPEG 24868, 75, 16.5–30.6 mm SL, R. Raiol, 21 Nov 2010; MPEG 24835, 60, 10.2–22.0 mm SL, R. Raiol, 10 Dec 2008; MPEG 24836, 32, 14.2–25.5 mm SL, R. Raiol, 10 Dec 2008. Following lots from Igarapé São Francisco (trib. rio Arapiuns), 2°27'54.0"S, 56°0'25.2"W: MPEG 24827, 26, 13.0–23.1 mm SL, W.B. Wosiacki, 21 Feb 2008; MPEG 24826, 8, 18.7–22.5 mm SL, W.B. Wosiacki, 20 Feb 2008; MPEG 24837, 25, 12.5–22.6 mm SL, R. Raiol, 11 Dec 2008; MPEG 14377, 74, 9.1–23.2 mm SL, A. Hercos, 1 Dec 2007; MPEG 14501, 1, 12.2 mm SL, Igarapé da Ponte, 2°10'49"S, 56°4'40"W; A. Hercos, 30 Nov 2007.

Diagnosis. *Hyphessobrycon montagi*, new species, can be diagnosed from all its congeners, with exception of *H. balbus* Myers, *H. bifasciatus* Ellis, *H. columbianus* Zarske & Géry, *H. condotensis* Regan, *H. flammeus* Myers, *H. griemi* Hoedeman, *H. isiri* Almirón, Casciotta & Körber, *H. itaparicensis* Lima & Costa, *H. savagei* Bussing, *H. sebastiani* Garcia-Alzate, Román-Valencia & Taphorn, *H. togoi* Miquelarena & López, *H. tortuguerae* Böhlke, and *H. weitzmanorum* Lima & Moreira by the possession of two well-defined humeral blotches. It can be diagnosed from all these species by the presence of a well-defined caudal peduncle blotch (vs. caudal peduncle blotch absent in all aforementioned species, with the exception of *H. isiri* and *H. togoi*), by an horizontally-elongated oval, very well-defined first humeral blotch (vs. first humeral blotch moderately conspicuous, vertically elongated, and approximately rectangular in shape), and by the fact that the first and second humeral blotches are connected via a narrow, short stripe (vs. humeral blotches not connected).

Description. Morphometric data of holotype and selected paratypes presented in Table 1. Body compressed, moderately high. Greatest body depth at dorsal fin origin. Dorsal profile of head convex from upper lip to vertical through middle of orbit; straight from latter point to tip of supraoccipital spine. Predorsal profile of body slightly convex, posteroventrally inclined along dorsal-fin base. Body profile straight to slightly convex from dorsal-fin base terminus to adipose fin; slightly concave between latter point to origin of anteriormost procurrent caudal-fin ray. Ventral profile of head and body convex from lower lip to anal-fin origin. Body profile along anal-fin base straight and posterodorsally inclined. Ventral profile of caudal peduncle slightly concave.

TABLE 1. Morphometric data of *Hyphessobrycon montagi*, new species. N = Number of specimens measured.

	N	Holotype	Range	Mean
Standard length (mm)	82	31.1	21.6–31.1	-
Percents of standard length				
Depth at dorsal-fin origin	82	36.7	28.3–37.7	32.0
Snout to dorsal-fin origin	82	50.8	47.7–52.6	49.9
Snout to pelvic-fin origin	82	47.9	42.1–49.7	46.6
Snout to anal-fin origin	82	63.7	57.3–64.8	60.8
Dorsal-fin length	76	29.9	24.8–33.6	29.5
Pectoral-fin length	80	22.2	18.6–26.6	22.9
Pelvic-fin length	76	17.7	15.0–22.8	18.7
Anal-fin base length	82	29.6	25.3–33.9	29.7
Caudal-peduncle depth	82	6.8	6.1–8.8	7.3
Caudal-peduncle length	81	11.6	10.3–16.3	13.8
Bony head length	82	27.7	26.1–29.8	27.9
Percents of head length				
Horizontal eye diameter	82	43.0	38.2–50.0	43.8
Snout length	82	25.6	20.3–30.0	24.4
Least interorbital distance	82	31.4	26.1–34.2	30.9
Upper jaw length	82	54.7	43.1–55.7	49.2

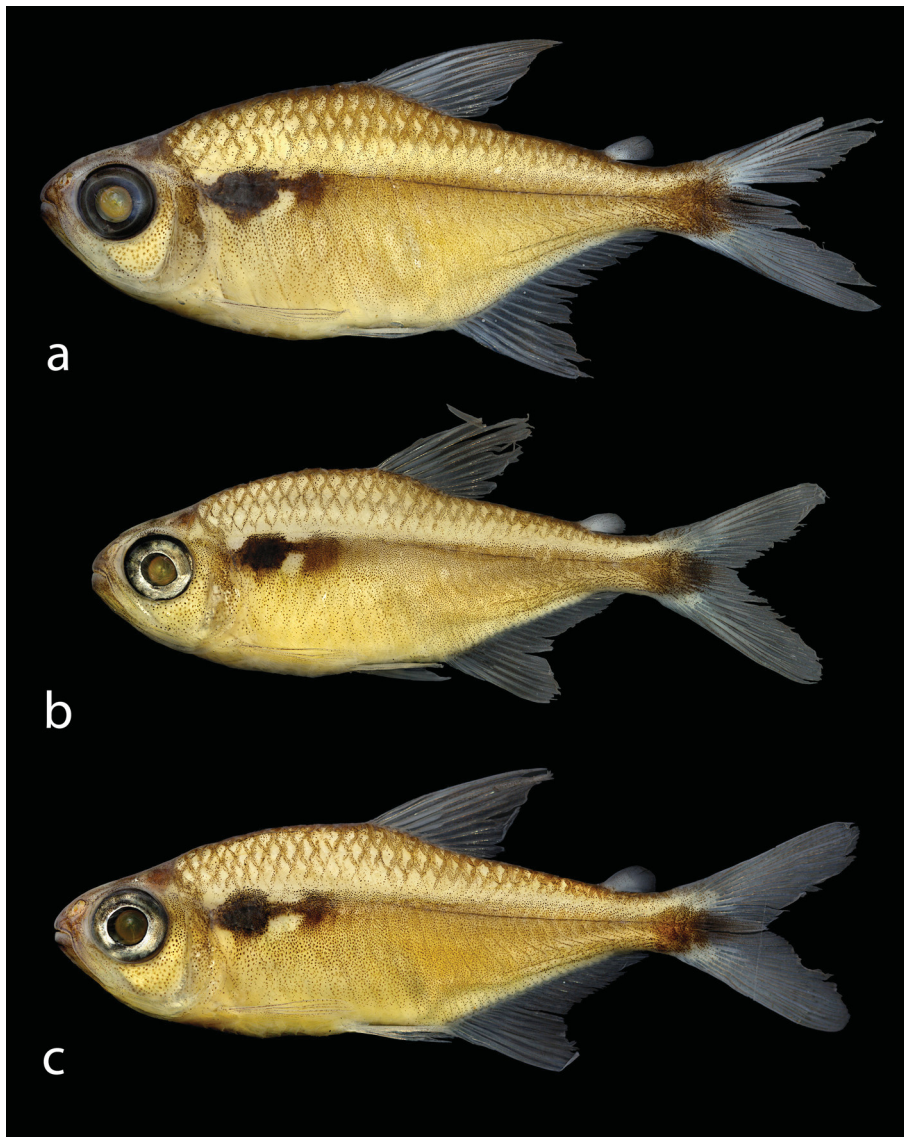


FIGURE 1. A) *Hyphessobrycon montagi*, new species, holotype, MPEG 29970, 31.1 mm SL: Brazil, Pará, Juruti, Igarapé Socó Barroso. B) *Hyphessobrycon montagi* new species, paratype, ZUEC 8319, 28.8 mm SL; Brazil, Pará, Juruti, Igarapé Mutum. C) *Hyphessobrycon montagi*, new species, paratype, MPEG 10344, 29.4 mm SL: Brazil, Pará, Juruti, Igarapé Mutum.



FIGURE 2. *Hyphessobrycon montagi*, new species, MPEG 30361, 27.1 mm SL, living specimen photographed immediately after collection; Brazil, Pará, Juruti, Igarapé Mutum.

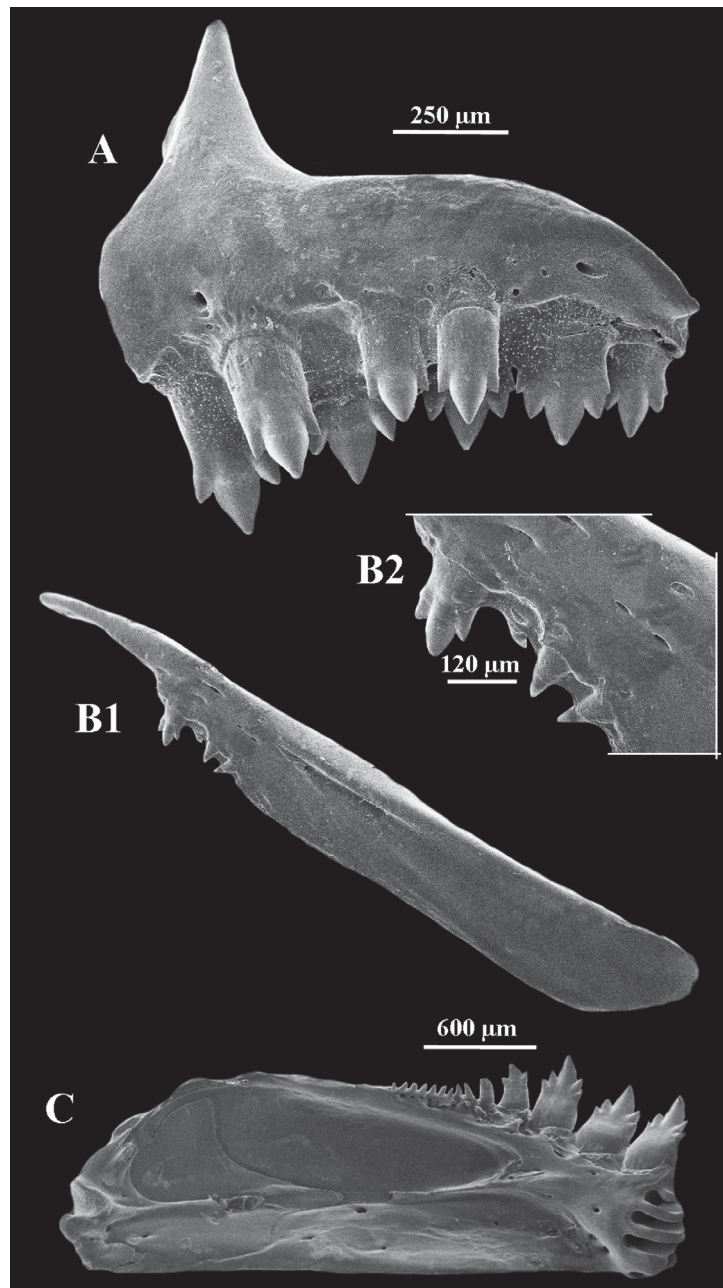


FIGURE 3. *Hyphessobrycon montagi*, new species, paratype, scanning electron micrographs (SEM) showing lateral view of left premaxillary (A), maxillary (B), and dentigerous portion of maxillary (B1), MPEG 24832, 28.6 mm SL; mesial view of left dentary (C), MPEG 24842, 27.2 mm SL.

Jaws equal, mouth terminal. Posterior terminus of maxilla reaching vertical through middle of orbit. Premaxillary teeth in two rows (Fig. 3). Outer row with 2*(31), 3(49), or 4(5) relatively compressed, tricuspidated, elongated teeth. Inner row with 5*(85) or 6(1) relatively compressed, tri- to pentacuspidated teeth. Maxilla with 2(1), 3(1), 4(4), or 5(4) uni- to tricuspidated teeth. Anteriormost teeth larger. Dentary with 13(4), 14(4), or 16(2) teeth, three anteriormost teeth larger, relatively bulky, pentacuspidated, fourth teeth smaller, tricuspidated. Remaining dentary teeth considerably smaller, cylindrical, all unicuspidated (Figure 3).

Scales cycloid, with 4 to 7 *radii* strongly marked, from focus to posterior border of scales; *circuli* weakly marked proximally, but absent distally (“*Hemigrammus* type” of Cockerell, 1914). Lateral line slightly decurved ventrally, incompletely pored, with 5(9), 6(28), 7(27), 8*(14), or 9(1) perforated scales. Lateral series scales including lateral line scales 27(2), 28(7), 29(17), 30*(19), 31(13), 32(7), 33(9), or 34(7). Horizontal scale rows between dorsal-fin origin and lateral line 5*(82). Horizontal scale rows between lateral line and pelvic-fin insertion

3*(82). Scales along middorsal line between distal tip of supraoccipital process and origin of dorsal fin 8–10. Horizontal scale rows around caudal peduncle 10*(28), 11(43), or 12(10). Single row of 3–5 scales covering base of anteriormost anal-fin rays. Caudal fin not scaled.

Dorsal-fin rays ii, 9* (ii, 8 in a single specimen, out of 82), not including small ossification anterior to first unbranched ray, discernible only in CS specimens, present in eight out of nine CS individuals. Dorsal fin pointed, last unbranched and two anteriormost branched rays considerably more elongated than remaining rays, forming roughly a falcated tip. Dorsal-fin origin slightly anterior to middle of standard length. Base of posteriormost dorsal-fin ray at vertical through anal-fin origin. First dorsal-fin pterygiophore inserting posterior to neural spine of 8(8) or 9(1) vertebrae. Adipose fin present. Anal-fin rays iii, 18(7), 19*(36), 20(29), 21(9), or 22(1). Anal fin with moderately developed anterior fin lobe, last unbranched and anteriormost 4–5 branched fin rays longer than remaining anal-fin rays. Anteriormost anal-fin pterygiophore inserting behind haemal spine of 13(1) or 14(8) vertebrae. Pectoral-fin rays i, 9(11), 10*(58), or 11(13). Pectoral fin pointed, its tip reaching vertical through pelvic-fin insertion. Pelvic-fin rays i, 7(82). Pelvic fin pointed, its tip reaching vertical through anal-fin origin. Caudal fin forked, lobes slightly rounded, similar in size. Principal caudal-fin rays 10+9(6), 10+8(2). Dorsal procurent caudal-fin rays 9(1), 10(4), or 11(4), and ventral procurent caudal-fin rays 7(1), 8(5), or 9(3). First gill arch with 1(2), 2(6), or 3(1) hypobranchial, 8(7) or 9(2) ceratobranchial, 1(9) on cartilage between ceratobranchial and epibranchial, and 5(7) or 6(2) epibranchial gill-rakers. Vertebrae 31(9), 32(8), 33(1), or 34(1). Supraneurals 3(1), or 4(17). Branchiostegal rays four; three branchiostegal rays originating from anterior ceratohyal and one from posterior ceratohyal.

Color in alcohol. Ground color tan, slightly darker dorsally. Silvery pigmentation in specimens retaining guanine present on opercular and infraorbital bones. Lower lip, snout, and top of head densely covered by small dark chromatophores, resulting in overall dark pigmentation. Opercle and infraorbital bones with large, numerous dark chromatophores. Gular area clear to tan.

Mid-dorsal scale row with dense concentration of dark chromatophores, forming a discrete, blurred line. First to second and upper half of the third lateral scale rows anterior to, and first and upper half of second lateral scale row posterior to, dorsal-fin terminus, with dense concentration of dark chromatophores on scale margins, forming a distinctive reticulated pattern. Fourth lateral scale row clear, with few scattered, small dark chromatophores, forming a distinctive clear lateral band extending from immediately above humeral area to caudal peduncle. Some specimens retaining guanine with an elongated silvery blotch at the upper half of caudal peduncle. Two humeral spots, both very conspicuous and connected to each other via a short stripe. First humeral blotch large, roughly oval in shape, intensely dark-pigmented, situated at the lateral-line level, extending longitudinally from first to fourth or fifth lateral line scales and horizontally two scales rows high. Second humeral blotch smaller than first humeral blotch, roughly shovel-shaped, slightly less pigmented than first one, extending longitudinally from sixth to seventh or eighth lateral-line scales, situated in scale row immediately above lateral line. Specimens retaining guanine with silvery pigmentation surrounding first humeral blotch. Narrow midlateral dark stripe formed by chromatophores at myosepta between hypaxial and epaxial bundles of muscles from blotch terminus to anterior portion of caudal peduncle. Lateral surfaces of body below midlateral line and posterior to second humeral blotch with dense concentration of small dark chromatophores, forming an overall smoky pattern. Lower portion of abdominal region and anal-fin basis clear, with few dark chromatophores. Narrow, subadjacent stripe of dark pigmentation located dorsal to anal-fin base, extending approximately along region where hypaxial musculature and muscles of anal fin meet, sub-parallel to anal-fin base. Caudal peduncle blotch large, rounded, situated on middle and lower portions of caudal peduncle and extending into middle caudal-fin rays. Caudal-fin lobes and remaining fins hyaline, with scattered, small dark chromatophores on interradiar membranes, except for distal portion of anteriormost dorsal- and anal-fins, which possess a slightly more dense concentration of dark chromatophores.

Color in life. Overall color pattern clear, light beige dorsally, plumbeous gray on anterior portion of lower half of body. Tip of snout and dentary light beige; upper half of eye dark red; a narrow longitudinal straight red line extending from area immediately above first humeral blotch to caudal peduncle, where red pigmentation extends across most of its upper half, above the dark caudal peduncle blotch. Yellowish pigmentation over pelvic fin, scattered across anterior portion of anal fin and dorsal fin (Figure 2).

Sexual dimorphism. None detected. Bony hooks on anal and pelvic fins of mature males, a common dimorphic feature among characids (Malabarba & Weitzman, 2003) were not found in any specimens. Since a large

sample of the species was examined ($n = 4402$), with specimens collected spanning most months of the year (February–June, August–December), it seems safe to assume that *Hyphessobrycon montagi* never develops fin hooks. See “Ecological notes”, from observations on the development of the urogenital papilla in males and females.

Distribution. So far only known from the headwaters of the rio Arapiuns (rio Branco and rio Aruã), lower rio Tapajós basin, and from a small direct tributary of the Rio Amazonas (igarapé da Ponte), Juruti municipality, Pará state, Brazil (Figure 4).

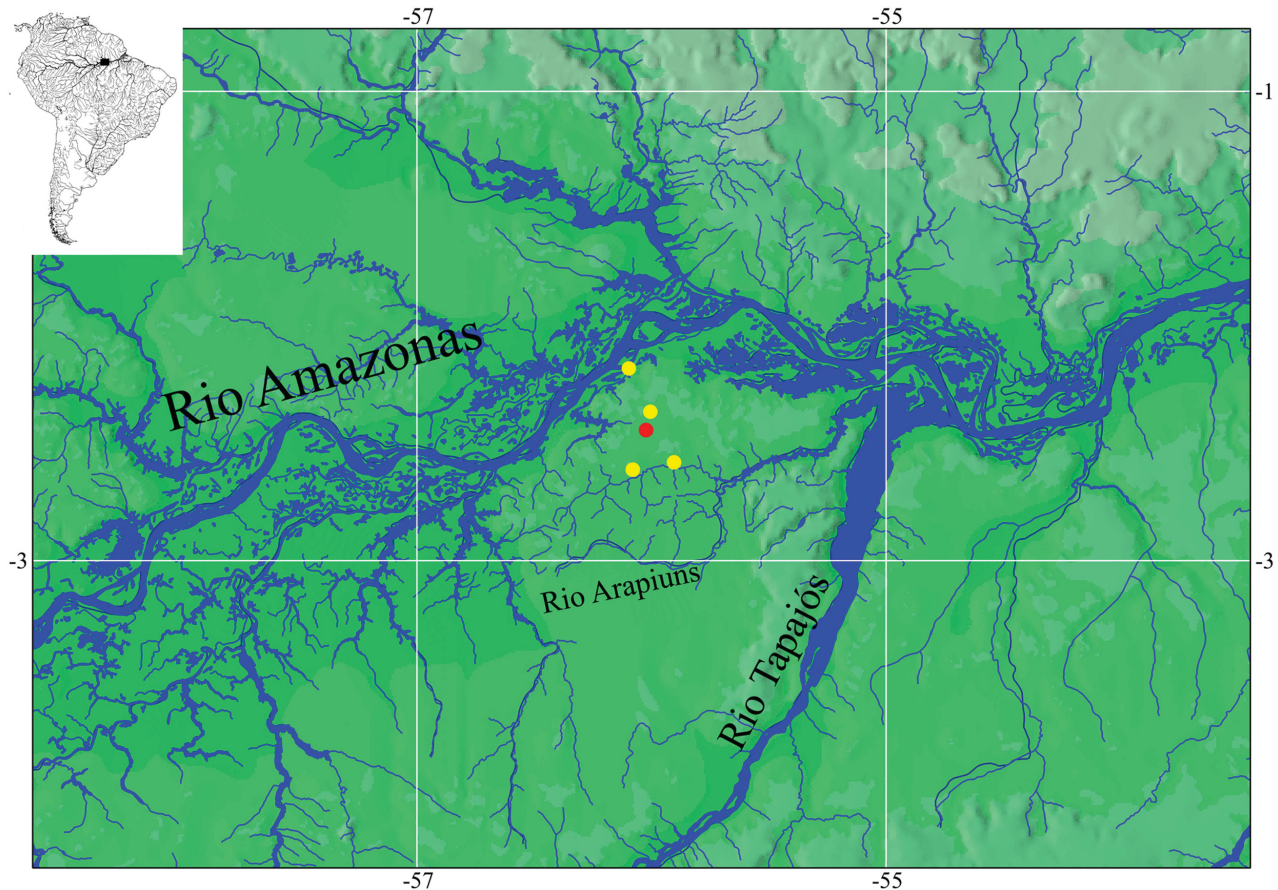


FIGURE 4. Map of middle Amazon, showing the distribution of *Hyphessobrycon montagi*, new species (type locality indicated by a red dot).

Ecological notes. *Hyphessobrycon montagi* was exclusively collected at clear-water terra firme streams, i.e., streams dissecting the uplands, above the periodically flooded igapó forest, as the Igarapé Socó Barroso, the type locality (Figure 5). Streams where *Hyphessobrycon montagi* specimens were collected range from 0.80 to 20 meters wide, with a maximum depth of 1.65 meters, and present moderate water current (0.1–0.7 m/s), with clear, sandy bottom with pebbles, mud, leaf litter, and submerged logs, often also presenting aquatic macrophytes. The pH ranged from 5.8 to 7.44, and the water temperature from 24.9 to 29.1°C. All collecting sites are within an unbroken, continuous primary/selectively logged forest area. Dissection revealed that females collected in March (MPEG 10336, 25.0–30.4 mm SL) and August (MPEG 10344, 27.7 mm SL) presenting a relative large, pointed urogenital papilla, presented ripe oocytes. Mature males also display a pointed papilla, which seems to be, however, slightly smaller than the one presented by mature females (MPEG 10344, 25.4–27.6 mm SL).

Etymology. The specific name, *montagi*, is in honor to our colleague and friend Luciano F.A. Montag (“Miúdo”), who collected part of the material of the species, and is in recognition of his contributions to the knowledge of the ichthyofauna from the lower portion of the Amazon basin. A genitive noun.



FIGURE 5. Type locality of *Hyphessobrycon montagi*, new species: Brazil, Pará, Juruti, Igarapé Socó Barroso.

Discussion

Hyphessobrycon montagi is readily distinguished from most of its congeners, as well to most species of the related genus *Hemigrammus*, by the possession of two humeral blotches and a caudal peduncle blotch, an unusual combination among those small characids. While only two, out of the 134 species of *Hyphessobrycon* species currently considered as valid display both two humeral blotches and a caudal-fin blotch (*Hyphessobrycon isiri* and *H. togoi*), among *Hemigrammus*, most species of the *Hemigrammus ocellifer* species-group, as well as *H. pretoensis* Géry, present both two humeral blotches and a caudal peduncle blotch (Lima & Sousa, 2009). However, none of these species possess the connection between the first and second humeral blotches, present in *Hyphessobrycon montagi*.

As for its putative relationships, *Hyphessobrycon montagi* might be related to *Hyphessobrycon heterorhabdus* (Ulrey), *H. amapaensis* Zarske & Géry, and *H. eschwartzae* García-Alzate, Román-Valencia & Ortega. The three aforementioned species share a well-defined, elongated humeral blotch, which is continuous with a midlateral, well-defined dark stripe that becomes blurred towards the caudal peduncle. The degree of blurredness is variable within *Hyphessobrycon heterorhabdus*, with some specimens presenting an almost continuous dark midlateral stripe which is only blurred near the caudal peduncle (e.g., INPA 41126, MZUSP 105778), whereas other specimens essentially present a blurred stripe along all its extension (e.g., MZUSP 105757, MZUSP 21883, MZUSP 5001, MZUSP 21883). This pattern is distinct from a continuous, intensely dark midlateral stripe, and lacking an obvious humeral blotch, present in several *Hyphessobrycon* species, such as *H. vilmae* Géry, *H. cachimbensis* Travassos, and *H. stegemanni* Géry, that were included along with *H. heterorhabdus* in Géry's (1977: 474–475, 478) “*Hy. heterorhabdus*-group”. In fact, the color pattern presented by *Hyphessobrycon heterorhabdus*,

H. amapaensis, and *H. eschwartzae* is more reminiscent of the pattern found in the species assigned by Géry (1977: 470–471) to his “*Hy. agulha* group”, which included, in addition to *H. agulha* Fowler, *H. loretoensis* Ladiges, *H. peruvianus* Ladiges, *H. metae* Eigenmann & Henn, and *H. herbertaxelrodi* Géry, which is composed by “lower half of the body dark, especially above anal fin; usually a horizontally elongate humeral spot, more or less united with the asymmetrical, broad band” (Géry, 1977: 470). Géry’s (1977) subdivisions of *Hyphessobrycon* were not deemed to be proposals of monophyletic groups, and as such can only be starting points for discussions on putative monophyletic entities within the genus (Weitzman & Palmer, 1997; Lima & Gerhard, 2001). García-Alzate, Román-Valencia & Taphorn (2008a), although remarking that Géry’s (1977) species-groups of *Hyphessobrycon* based on color patterns were “artificial”, decided to build up within his definition of a *Hyphessobrycon heterorhabdus* group, for species presenting a “dark stripe along the mid-axis of the body”, and adding to it *H. sovichthys* Schultz, *H. fernandezi* Fernandez-Yépez, *H. diancistrus* Weitzman, and the then newly described *H. tuyensis* García-Alzate, Román-Valencia & Taphorn, and *H. paucilepis* García-Alzate, Román-Valencia & Taphorn. Most species included by García-Alzate, Román-Valencia & Taphorn (2008a) within their newly expanded “*Hyphessobrycon heterorhabdus* group” possess a continuous, relatively broad dark midlateral stripe and lack an obvious humeral blotch, being consequently on this regard more similar to congeners as *H. vilmae*, *H. cachimbensis*, and *H. stegemanni*, among others, than to *H. heterorhabdus*. The only exception was *Hyphessobrycon diancistrus*, a species which actually lacks a humeral blotch and has only a very faint midlateral stripe, and which would actually probably fit better the “group a” of Géry (1977) (“species without spots or bands on body”), though J. Géry himself thought that it rather should be transferred to *Hemigrammus* (pers. comm. to FCTL, September 2005). In fact, with the exception of *Hyphessobrycon eschwartzae*, *H. oritoensis* García-Alzate, Román-Valencia & Taphorn (discussed in more detail below), *H. tuyensis*, *H. paucilepis* and *H. taphorni* García-Alzate, Román-Valencia & Ortega (the three latter presenting a continuous dark midlateral stripe and no hint of a humeral blotch, and consequently more similar to *H. vilmae*, *H. cachimbensis*, and *H. stegemanni*, among other species), none of the *Hyphessobrycon* species described by García-Alzate and co-workers (García-Alzate, Román-Valencia & Taphorn, 2010; García-Alzate, Román-Valencia & Prada-Pedrerros, 2010) actually fit adequately into Géry’s (1977) *Hyphessobrycon heterorhabdus* group, even considering its uncertain limits, and certainly not into the more restricted and putatively monophyletic assemblage proposed herein. All species described in these papers possess vertically elongated, single humeral blotches and either a faint, narrow or blurred midlateral stripe not continuous with the humeral blotch, and some a caudal peduncle blotch, and would rather fit into Géry’s (1977) subdivisions either the “group b” (“species with one or two humeral spots”), or, even more plausibly, the *Hemigrammus bellottii* group, whose species present “a humeral spot” and “usually a narrow longitudinal line along body” or his “*Hemigrammus ocellifer* group”, which possess “one or two humeral spots; a caudal spot; usually a longitudinal line” (Géry, 1977: 482, 491, 502).

Hyphessobrycon oritoensis, described by García-Alzate, Román-Valencia & Taphorn (2008b) from a tributary of the Río Putumayo (upper Amazon basin) in Colombia, was included by these authors into the *Hyphessobrycon heterorhabdus* group sensu Géry, 1977. This species possess a well-developed midlateral dark stripe which is preceded and continuous with a humeral blotch, and would potentially also fit into the restricted *Hyphessobrycon heterorhabdus* species-group proposed herein. However, *Hyphessobrycon oritoensis* possess an apparently more diffuse, vertically-oriented humeral blotch, and a midlateral stripe always reaching the caudal peduncle, contrasting with the well-defined, horizontally-elongated humeral blotch and the typically truncated/blurred midlateral stripe towards the caudal peduncle present in *Hyphessobrycon heterorhabdus*, *H. amapaensis*, and *H. eschwartzae*. Consequently, we did not consider it to be a member of the putatively monophyletic *Hyphessobrycon heterorhabdus*-group herein proposed.

García-Alzate, Román-Valencia & Prada-Pedrerros (2010: 444) cite two purported synapomorphies for his “*Hyphessobrycon heterorhabdus* group”, i.e., the presence of 13–14 epipleurals and metapterygoid “lacking ventral projection and not into contact with the symplectic”. García-Alzate, Román-Valencia & Ortega (2013: 870) also mentioned two purported synapomorphies for a clade that would include *Hyphessobrycon eschwartzae*, *H. amapaensis*, and *H. agulha*, viz., the presence of six or less gill-rakers on the first ceratobranchial and tip of pterotic projecting beyond “medial area in relation to extrascapular”. It is difficult to assess these potential synapomorphies because neither the composition of their *Hyphessobrycon heterorhabdus* group (or else the remaining species of *Hyphessobrycon* and related genera used in the analysis), nor the remaining characters (and alternative character-states for the purported synapomorphies mentioned) used in the analysis that recovered these

purported clades were presented. In the absence of a published thorough analysis of the relationships of *Hyphessobrycon*, *Hemigrammus*, and other related genera, hypothesis of putative monophyletic assemblages within these genera should only be presented using characters clearly demonstrated as apomorphic within these genera (e.g., Lima & Sousa, 2009; Ingenito *et al.*, 2013), with the proviso that such putative monophyletic groups should be better scrutinized once detailed phylogenetic hypotheses for the group become available.

Returning to the putative relationship among *Hyphessobrycon montagi* and the species of the *H. heterorhabdus* species-group, as restricted in the current paper, although the dark markings present of *H. montagi* are quite distinct from the ones presented by the species of the *H. heterorhabdus* species-group, they share an overall similar body shape, as well as the presence, in living specimens, of a longitudinal red stripe, extending along the body above the midlateral line, as well as the upper half of the eye red. This character was previously mentioned by Zarske & Géry (1998: 25) as one of the features indicating a close relationship between *Hyphessobrycon heterorhabdus* and *H. amapaensis*. Although the presence of this type of coloration in life is by no means restricted to these species (it is also found, for example, in *Hyphessobrycon agulha*, which is, as discussed above, also possibly related to the *H. heterorhabdus* species-group; see. e.g., Lima *et al.*, 2013: 276, upper photo), it might eventually prove to be a potential synapomorphy for a more inclusive *H. heterorhabdus* species-group. Although we acknowledge that the evidence pointing a potential relationship between *Hyphessobrycon montagi* and the species of the *H. heterorhabdus* species-group is rather tenuous at the moment, we consider valid to provide a hypothesis of relationships for it, as preliminary as it may seem, than none. Again, a thorough analysis of the relationships of *Hyphessobrycon*, *Hemigrammus*, and other related genera is required to advance the understanding of the relationships of these large, paraphyletic, and relatively morphologically-conserved taxa.

Comparative material examined. *Hyphessobrycon agulha*: MPEG 8296, 67, 21.2–36.5 mm SL, Brazil, Pará, Juruti; MPEG 8301, 106, 21.3–44.9 mm SL, Brazil, Pará, Juruti; ZUEC uncat., 6, 40.7–43.6 mm SL, Peru, Loreto, Jenaro Herrera. *Hyphessobrycon amapaensis*: MCP 43636, 8, 16.0–26.5 mm SL, Brazil, Amapá, Mazagão; MZUSP 29898, 9, 19.3–29.0 mm SL, Brazil, Amapá, rio Araguari. *Hyphessobrycon cf. cachimbensis*: ZUEC uncat., 13, 17.8–21.2 mm SL, Brazil, Mato Grosso, rio Aripuanã. *Hyphessobrycon diancistrus*: MZUSP 96401, 11, 26.5–29.1 mm SL, Venezuela, Bolívar, Río Orinoco drainage. MZUSP 15744, 1, 29.9 mm SL, Brazil, Pará, rio Trombetas drainage. MZUSP 29843, 147, 31.0–33.3 mm SL, Brazil, Amazonas, rio Negro drainage. MZUSP 29846, 80, 27.3–32.4 mm SL, Brazil, Amazonas, rio Negro drainage. *Hyphessobrycon eschwartzae*: MZUSP 106700, 4, 19.3–22.5 mm SL, Peru, Madre de Dios, Río Planchon; MZUSP 106708, 3, 24.6–26.1 mm SL, Peru, Madre de Dios, Río Buyuoc. *Hyphessobrycon fernandezi*: MZUSP 105445, 28, 10.1–22.7 mm SL, Venezuela, Falcón, Tucacas. *Hyphessobrycon herbertaxelrodi*: MZUSP 103764, 20, 21.0–27.3 mm SL, Brazil, Mato Grosso do Sul, Coxim; MZUSP 103837, 50, 12.7–26.6 mm SL, Brazil, Mato Grosso do Sul, Coxim; MZUSP 90046, 15, 19.6–30.6 mm SL, Brazil, Mato Grosso, rio Sepotuba basin. *Hyphessobrycon heterorhabdus*: INPA 41126, 2, 23.5–28.0 mm SL, Brazil, Pará, Santarém. MZUSP 105757, 17, 21.4–27.0 mm SL, Brazil, Pará, Santo Antônio do Tauá, trib. Rio Tauá; MZUSP 21883, 106, 18.7–30.0 mm SL, Pará, Itaituba, rio Tapajós basin; MZUSP 5001, 31, 18.8–30.9 mm SL, Brazil, Pará, Santa Isabel, Igarapé do Tubo; MZUSP 105778, 258, 21.9–30.7 mm SL, Brazil, Pará, Barcarena, rio Tocantins basin. *Hyphessobrycon loretoensis*: ZUEC uncat., 1, 25.3 mm SL, Peru, Loreto, Iquitos; MZUSP 43647, 3, 19.2–19.7 mm SL, Peru, Loreto, Jenaro Herrera; MZUSP 85591, 3, 22.8–22.9 mm SL, Peru, Loreto, Jenaro Herrera. *Hyphessobrycon metae*: MZUSP 103067, 20, 23.1–27.4 mm SL, Venezuela, Bolívar, Caño Oche. *Hyphessobrycon peruvianus*: MZUSP 85610, 7, 32.4–39.1 mm SL, Peru, Loreto, Jenaro Herrera; MZUSP 85635, 2, 26.8–30.2 mm SL, Peru, Loreto, Jenaro Herrera. *Hyphessobrycon stegemanni*: MZUSP 40842, 35, 19.6–24.6 mm SL, Brazil, Tocantins, Arraias. *Hyphessobrycon vilmae*: MZUSP 61128, 87, 10.0–25.9 mm SL, Brazil, Mato Grosso, rio Arinos basin.

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