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A New *Hyplessobrycon* (Characiformes: Characidae) from the Guiana Shield in Northern Brazil

Tiago C. Faria¹, Flávio C. T. Lima¹, and Wolmar B. Wosiacki²

A new species of *Hyplessobrycon* from a tributary of the Rio Paru do Oeste (Rio Trombetas basin), at the lower Amazon basin draining the Guiana Shield region in Pará State, Brazil, is described. The new species presents a unique combination of an irregularly-shaped humeral blotch, a broad diffuse midlateral stripe, and a roughly triangular caudal peduncle blotch. The new species is herein included in the *Hyplessobrycon agulha* species-group, and comparisons with species belonging to this group and to a similar-looking non-congener, *Hemigrammus bellottii*, are presented.

Uma nova espécie de *Hyplessobrycon* é descrita de um tributário do rio Paru do Oeste (bacia do rio Trombetas), na região do baixo rio Amazonas que drena o Escudo das Guianas no estado do Pará, Brasil. A nova espécie apresenta uma combinação única de uma mancha umeral de forma irregular, uma faixa longitudinal larga e difusa, e uma mancha aproximadamente triangular no pedúnculo caudal. A nova espécie é incluída no grupo *Hyplessobrycon agulha*, e comparações com as espécies pertencentes a este grupo e a um não-congênera semelhante, *Hemigrammus bellottii*, são apresentadas.

HYPLESSOBRYCON, with 159 valid species (Faria et al., 2018; Ohara et al., 2019; Teixeira et al., 2020), is currently the second most species-rich genus in Characidae, after *Astyanax*, with new species being described at a steady rate. Species of this genus are among the most common fishes in small streams across the Neotropical region. The genus is currently considered non-monophyletic by both molecular and morphological phylogenies (e.g., Oliveira et al., 2011; Miranda, 2019), and it was recently included in the subfamily Stethaprioninae by Miranda (2019). *Hyplessobrycon* is still defined according to the definition presented by Durbin (in Eigenmann, 1918), which consists in the combination of a suite of non-exclusive characters: an incompletely pored lateral line, two rows of teeth on the premaxilla, with the inner row having five or more teeth, and caudal fin with scales present only basally.

In spite of its non-monophyletic status, hypotheses of putative monophyletic groups have been proposed for groups within *Hyplessobrycon*, or even among *Hyplessobrycon* and other closely related genera, such as *Hemigrammus*, using primarily color patterns (e.g., Weitzman and Palmer, 1997; Lima et al., 2014). During a broad survey of the biodiversity (flora and vertebrate fauna) of the northern portion of Pará State conducted by Museu Paraense Emílio Goeldi personnel between 2008–2009 as part of the “Projeto Diagnóstico da Biodiversidade das Unidades de Conservação Estaduais do Mosaico Calha Norte, Estado do Pará” (see Ávila-Pires et al., 2010 for details), several remote, biologically poorly known sites situated in tributaries of the Amazon basin draining the Guiana Shield were sampled, which resulted in the discovery of some undescribed fish species (e.g., Wosiacki et al., 2011; Birindelli et al., 2013; Wosiacki and Miranda, 2013). In the present contribution, an additional new species discovered during this survey is described, a species of *Hyplessobrycon* with a color pattern similar to congeners belonging to the *Hyplessobrycon agulha* species-group (Géry, 1977; Costa and

Géry, 1994; Ohara and Lima, 2015). The aim of the present contribution is to describe this new taxon and discuss its putative relationships.

MATERIALS AND METHODS

Counts and measurements were taken on the left side of specimens, whenever possible, to the nearest 0.1 mm, following Fink and Weitzman (1974) and Menezes and Weitzman (1990), except for the counts of horizontal scale rows below the lateral line, which were counted to the pelvic-fin insertion. Horizontal scale rows between the dorsal-fin origin and the lateral line do not include the scale of the predorsal series located just forward of the first dorsal-fin ray. Measurements are presented as percentages of standard length (SL), with the exception of subunits of the head, which are presented as percentages of head length (HL). Counts of vertebrae, supraneurals, procurrent caudal-fin rays, and teeth cusps were taken from cleared and stained specimens (CS) prepared according to Taylor and Van Dyke (1985). Total vertebral count includes the Weberian apparatus, counted as four elements, and the preural centrum 1 plus ural centrum 1 (PU1+U1) of the caudal region counted as a single vertebral element. In the description, counts are followed by their frequency in parentheses, and an asterisk indicates the count of the holotype. Institutional acronyms follow Sabaj (2019).

Hyplessobrycon zoe, new species

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Figures 1–3; Table 1

Holotype.—MPEG 38859, 29.7 mm SL, Brazil, Pará, Óbidos, Estação Ecológica Grão Pará Centro, stream tributary of Rio

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Fig. 1. (A) *Hyphessobrycon zoe*, MPEG 38859, 29.7 mm SL, holotype, female; (B) ZUEC 17129, 27.2 mm SL, paratype, female; (C) MPEG 18200, 28.2 mm SL, paratype, female; all from Brazil, Pará, Óbidos, Rio Paru do Oeste basin.

Urucuriana, Rio Paru do Oeste basin, 0°38'10"N, 55°43'24"W, F. Silva and W. Mota, 20 January 2009.

Paratypes.—All from Brazil, Pará, Óbidos, Rio Trombetas basin, Estação Ecológica Grão Pará Centro: CAS 247124, 5, 23.9–26.6 mm SL, INPA 59057, 5, 22.5–27.3 mm SL, MPEG 18181, 61, 21.6–29.1 mm SL, 3 CS, ZUEC 17128, 5, 23.0–28.5

mm SL, stream tributary of Rio Urucuriana, Rio Paru do Oeste basin, 0°38'22"N, 55°43'33"W, F. Silva and W. Mota, 22 January 2009; FMNH 143255, 5, 21.9–27.4 mm SL, MPEG 18198, 35, 16.6–29.1 mm SL, stream tributary of Rio Paru do Oeste, 0°37'16"N, 55°43'32"W, F. Silva and W. Mota, 19 January 2009; MPEG 18170, 16, 22.4–28.7 mm SL, stream tributary of Rio Paru do Oeste, 0°38'15.3"N, 55°43'31.2"W, F.

Table 1. Morphometric data of *Hyphessobrycon zoe*. Range includes holotype.

	Holotype	Range	Mean±SD	n
Standard length (mm)	29.7	22.9–29.7		50
Percent of standard length				
Greatest body depth	30.6	25.4–34.6	30.2±2.1	50
Snout to dorsal-fin origin	50.8	49.6–53.2	51.8±1.0	50
Snout to pelvic-fin origin	47.5	44.5–50.0	47.5±1.4	50
Snout to anal-fin origin	62.3	59.7–65.9	63.7±1.6	50
Caudal peduncle depth	8.1	6.9–9.7	8.2±0.5	50
Caudal peduncle length	12.4	11.2–17.0	13.9±1.2	49
Pectoral-fin length	20.2	17.4–23.1	20.1±1.3	50
Pelvic-fin length	15.8	13.7–18.6	16.1±1.0	50
Length of dorsal-fin base	14.8	11.1–15.7	13.1±1.0	50
Dorsal-fin length	24.2	24.2–30.1	27±1.3	45
Anal-fin base length	27.9	23.2–27.9	24.8±1.3	49
Head length	25.6	24.8–27.7	26.7±0.7	50
Percent of head length				
Orbital diameter	36.8	31.9–42.4	38.5±1.9	50
Snout length	23.7	21.4–31.9	26.5±2.0	50
Interorbital width	31.6	28.1–35.5	31.7±1.6	50
Maxillary length	46.0	40.3–51.5	44.7±2.1	50

mode 13), and from *H. mutabilis* by possessing a conspicuous and irregularly-shaped humeral blotch with vertical and longitudinal components (vs. an inconspicuous and narrow humeral blotch with a single vertically-elongated component). See the Discussion for further comments on the diagnosis of the species.

Description.—Morphometric data for holotype and paratypes in Table 1. Body compressed. Greatest body depth at vertical through dorsal-fin origin. Dorsal profile of head slightly convex from upper lip to vertical through posterior nostril, straight from that point to tip of supraoccipital spine. Dorsal profile of body slightly convex from latter point to anterior terminus of dorsal fin. Dorsal-fin base straight to slightly convex, posteroventrally slanted, approximately straight from posterior terminus of dorsal fin to adipose-fin insertion and slightly concave between adipose-fin insertion and origin of anteriormost dorsal procurrent caudal-fin ray. Ventral profile of head and body convex from tip of lower jaw to anal-fin anterior terminus. Anal-fin base straight, posterodorsally slanted. Ventral profile of caudal peduncle slightly concave.

Jaws equal, mouth terminal. Posterior terminus of maxilla reaching vertical through anterior margin of iris. Maxilla approximately at 45-degree angle relative to longitudinal axis of body. Nostrils close to each other, anterior opening oval, posterior opening crescent-shaped. Premaxillary teeth in two rows. Outer teeth row with 2(4), 3(21), or 4(7) uni- to tricuspid teeth. Inner row with 5(31) tri- to pentacuspoid teeth, symphyseal tooth of inner series narrower than adjacent teeth. Maxilla with 2(2) or 4(1) conical to tricuspid teeth. Dentary with 13(1) or 14(1) teeth, anteriormost 4(1) or 5(1) teeth larger, tri- to tetracuspoid. Remaining teeth considerably smaller and conical. Central cusp of all teeth more developed than remaining lateral cusps.

Scales cycloid. Three to seven radii strongly marked, circuli well marked anteriorly, weakly marked posteriorly. Lateral line slightly deflected downward and incompletely pored, with 5(4), 6(10), or 7*(32) perforated scales. Longitudinal

scale series including lateral-line scales 30(2), 31(3), 32(8), 33*(9), 34(6), or 35(1). Longitudinal scale rows between dorsal-fin origin and lateral line 5*(45) or 6(1). Longitudinal scale rows between lateral line and pelvic-fin origin 3*(40) or 4(9). Predorsal scales 9(11), 10 (20), 11*(15), or 12(2). Circumpeduncular scales 12*(23). Caudal fin with few small scales basally.

Dorsal-fin rays ii, 8(2), or ii, 9*(47). Dorsal-fin origin slightly anterior from middle of standard length. First dorsal-fin pterygiophore inserting behind neural spine of 9th(1) or 10th(2) vertebrae. Adipose fin present. Anteriormost anal-fin pterygiophore inserting posterior to haemal spine of 15th(2) or 16th(1) vertebrae. Anal-fin rays iv, 17(5), 18 (21), 19*(18), or 20(3). Last unbranched and first to third anteriormost branched rays distinctly longer than remaining rays, subsequent rays gradually decreasing in size; distal margin of anal fin slightly concave, with distinctive anterior lobe. Pectoral-fin rays i, 9(9), 10(25), 11*(12), or 12(1). Pelvic-fin rays i, 6(3) or 7*(46). Tip of pelvic fin reaching anteriormost anal-fin rays. Caudal fin forked, lobes roughly rounded and of similar size. 9(2) or 10(1) dorsal procurrent caudal-fin rays, and 8(2) ventral procurrent caudal-fin rays.

Vertebrae 29(1), 30(1), or 31(1). Supraneurals 4(1) or 5(2), with distalmost portion wider. Branchiostegal rays 4. First gill arch with 1(2) hypobranchial, 1(2) on cartilage between hypobranchial and ceratobranchial, 8(1) or 9(1) ceratobranchial, 1(2) on cartilage between ceratobranchial and epibranchial, and 5(2) epibranchial gill rakers.

Color in alcohol.—Overall body color beige, clearer ventrally. Small dark chromatophores densely concentrated on dorsal surface of head, premaxilla, anterior portion of maxilla and dentary, and anterior and posterior margins of eye. Opercle with silvery hue. Ventral portion of head light brown. Predorsal region dark brown. Dorsalmost three horizontal scale rows with reticulated pattern formed by dark chromatophores concentrated at posterior margin of scales. Dark humeral blotch very conspicuous, composed by two regions, lower half darker and longitudinally elongated, and dorsal

portion, typically diffuse. Lower half occupying lateral-line scales and first scale row above lateral-line scales, composed by closely arranged dark chromatophores, roughly rectangular in shape. Dorsal expansion occupying second and third series of scales above lateral-line scales, composed by relative less dense concentration of dark chromatophores, when compared to lower half. Trunk area immediately ahead of humeral blotch completely devoid of chromatophores. Lateral stripe diffuse, starting immediately behind humeral blotch, its anterior portion moderately broad, upper chromatophores small, lower chromatophores relatively large. Midlateral stripe broadening and becoming more conspicuous at level of beginning of anal fin, and extending vertically from longitudinal narrow dark stripe at lateral septum to area immediately above septum between hypaxial muscles and muscles of anal-fin base. Area immediately above midlateral stripe almost completely devoid of dark chromatophores, forming longitudinal clear area. Dark chromatophores above anal-fin base arranged along myocommata of hypaxial muscles. Midlateral dark stripe expanding ventrally at caudal peduncle, forming conspicuous caudal peduncle blotch, roughly triangular in shape. Dorsal, anal, and caudal fins with dark chromatophores scattered mainly over interradial membranes and distal region in dorsal fin. Adipose fin with few dark chromatophores, mainly along distal margin. Some specimens (e.g., MPEG 18181) with overall coloration considerably lighter and dark markings less conspicuous.

Sexual dimorphism.—Mature males have small bony hooks along the pelvic-fin rays and along the distal half of anteriormost 4–5 branched anal-fin rays (MPEG 18181, 11, 22.9–24.7 mm SL; MPEG 18198, 9, 18.3–23.7 mm SL; MPEG 18200, 4, 23.4–24 mm SL).

Ecological notes.—*Hyphessobrycon zoe* was collected from small forest creeks with rocky/sandy bottom, in a hilly landscape (altitudes ranging from 330–370 meters a.s.l.), in a contact area between savannah and rainforest (Aleixo et al., 2010). Gut content of three specimens (MPEG 18181, 21.0–27.8 mm SL) contained ant heads, a chironomid larvae, and unidentified triturated matter.

Distribution.—*Hyphessobrycon zoe* is only known from small tributaries of the Rio Urucuriana, a tributary of Rio Paru do Oeste, itself a tributary of the Rio Trombetas basin, Amazon basin, Pará State, Brazil (Fig. 3).

Etymology.—The specific epithet honors the Zo'é, a Tupi-speaking people living at the Rio Cuminapanema, a tributary of Rio Curuá, very close to the area from where *Hyphessobrycon zoe* is known. The Zo'é were only discovered by the western society during the 1970s and contacted during the 1980s, being one of the indigenous people from South America that has retained more of its traditional culture (Hemming, 2003). A noun in apposition.

DISCUSSION

Although the genus *Hyphessobrycon* is clearly non-monophyletic, there are some putative monophyletic groups proposed among the species of the genus (e.g., Weitzman and Palmer, 1997; Ingenito et al., 2013; Lima et al., 2014). Among the groups proposed within the genus, the *Hyphessobrycon agulha*

species-group (Géry, 1977; Costa and Géry, 1994) is more similar to *Hyphessobrycon zoe* in regard to color pattern.

The *Hyphessobrycon agulha* species-group, proposed originally by Géry (1977) and later expanded by subsequent authors (Costa and Géry, 1994; Ohara and Lima, 2015; Zarske, 2015, 2016; García-Alzate et al., 2017; Moreira and Lima, 2017), is currently composed by *H. agulha*, *H. clavatus*, *H. eschwartzae*, *H. herbertaxelrodi*, *H. klausanni*, *H. loretoensis*, *H. lucenorum*, *H. margitae*, *H. metae*, *H. mutabilis*, and *H. peruvianus*. Species belonging to the group typically possess a humeral blotch (inconspicuous in some species) followed by a broad, blurred midlateral stripe. Additionally, *Hyphessobrycon wadai*, although not associated with this group in its original description, can also be included as it has the diffuse broad lateral stripe shared by its component species (Marinho et al., 2016a). There is no evidence, however, that the *Hyphessobrycon agulha* species-group is monophyletic, although it seems likely that some of its component species are closely related to each other (e.g., *H. herbertaxelrodi* and *H. lucenorum*; Ohara and Lima, 2015). *Hyphessobrycon zoe* possesses a comparatively poorly developed diffuse lateral stripe, only conspicuous after the midbody. Most species included in the *Hyphessobrycon agulha* species-group possess a diffuse lateral stripe that is more conspicuous and extends anteriorly to the humeral blotch, although apparently the intensity of the stripe may be variable intraspecifically. For example, photos of living specimens of *Hyphessobrycon peruvianus* typically show a developed broad stripe extending anteriorly to the humeral blotch (e.g., Zarske, 2016: 111, fig. 5), while preserved specimens often have the stripe only conspicuous after the midbody (e.g., Marinho et al., 2016b: fig. 4). The same seems to be valid for *Hyphessobrycon wadai* (compare figs. 1 and 2 in Marinho et al., 2016a). However, the diffuse lateral stripe in *Hyphessobrycon zoe* is consistently less conspicuous than in any other species included in the *Hyphessobrycon agulha* species-group. Additionally, *Hyphessobrycon zoe* differs from all other species included in the *Hyphessobrycon agulha* species-group, except for *H. agulha* and *H. mutabilis*, by presenting a caudal peduncle blotch.

The humeral blotch of *Hyphessobrycon zoe* is very conspicuous and distinct in shape from any of the species included in the *Hyphessobrycon agulha* species-group, for being irregular in shape, with a dorsal projection, while in the remaining species of the group, it is either roughly oval in shape (e.g., *Hyphessobrycon agulha*, *H. eschwartzae*, *H. herbertaxelrodi*, and *H. lucenorum*), roughly triangular (*H. peruvianus*), or vertically elongated (*H. klausanni*, *H. margitae*, *H. mutabilis*, and *H. wadai*). It resembles the humeral blotch present in *Hemigrammus bellottii*, although in the latter species there is a short backward elongation of the blotch (e.g., Géry, 1977: 494; Lima et al., 2013: 256), while the humeral blotch in *Hyphessobrycon zoe* is more compact, with no discernible backward projection. *Hemigrammus bellottii* lacks the diffuse dark lateral pigmentation and the caudal peduncle blotch, present in *Hyphessobrycon zoe*.

We herein include *Hyphessobrycon zoe* within the *Hyphessobrycon agulha* species-group, noticing, however, that a definitive answer regarding its relationships must await a full phylogenetic appraisal of *Hemigrammus*, *Hyphessobrycon*, and related genera using both morphological and molecular data.

NOTE ADDED IN PROOF

In a recently published paper, Dutra et al. (2020) mentioned *Hyphessobrycon zoe*, misidentified as *Hyphessobrycon cf. agulha* (Dutra et al., 2020: 30, 33, fig. 5b), based on the same specimens studied in the present paper. The sites where specimens of *Hyphessobrycon zoe* were collected were cited to belong to the rio Cuminá basin, which is another name for the rio Paru do Oeste.

MATERIAL EXAMINED

Hemigrammus bellottii: NMW 57254, 4 of 9, 24.6–29.8 mm SL “Tabatinga” (Brazil, Amazonas, Rio Solimões at Tabatinga), syntypes of *Tetragonopterus bellottii*; ZUEC 7237, 39, 17.9–29.6 mm SL, Brazil, Rondônia, Rio Madeira basin; ZUEC 15092, 41, 24.2–30.5 mm SL, ZUEC 15338, 140, 21.7–29.6 mm SL, Brazil, Amazonas, Rio Solimões basin; ZUEC 15152, 59, 23.9–33.9 mm SL, Brazil, Amazonas, Rio Tefé basin.

Hyphessobrycon agulha: ZUEC 8527, 54, 24.1–44.9 mm SL, ZUEC 8534, 40, 17.2–43.3 mm SL, Brazil, Pará, Rio Arapiuns basin; ZUEC 10204, 6, 31.2–39.1 mm SL, ZUEC uncat., 1, 33.7 mm SL, Peru, Amazonas, Río Ucayali basin; ZUEC 13668, 17, 13.3–42.8 mm SL, Brazil, Amazonas, Rio Juruá basin; ZUEC 14883, 17, 21.5–27.6 mm SL, Brazil, Amazonas, Rio Solimões basin; ZUEC 14956, 6, 31.7–34.3 mm SL, ZUEC 15027, 16, 31.5–38.5 mm SL, Brazil, Amazonas, Rio Tefé basin; ZUEC 16125, 8, 42.1–48.5 mm SL, ZUEC 16209, 13, 41.6–41.8 mm SL, Brazil, Amazonas, Rio Negro basin; ZUEC uncat., 11, 28.4–35.4 mm SL, Peru, Loreto, Río Itaya basin.

Hyphessobrycon ericae: see Moreira and Lima (2017).

Hyphessobrycon eschwartzae: ZUEC 11402, 30, 19.0–29.1 mm SL, Peru, Madre de Dios, Río Madre de Dios basin.

Hyphessobrycon herbertaxelrodi: MZUSP 123572, 50, 17.2–34.1 mm SL, ZUEC 17132, 10, 25.4–32.5 mm SL, Brazil, Mato Grosso, Rio Sepotuba basin.

Hyphessobrycon loretoensis: ZUEC 8657, 1, 23.5 mm SL, ZUEC 8658, 2, 19.8–21.2 mm SL, Peru, Loreto, Río Itaya basin; ZUEC 15042, 3, 20.4–21.1 mm SL, ZUEC 15173, 1, 21.6 mm SL, Brazil, Amazonas, Rio Solimões basin.

Hyphessobrycon lucenorum: ZUEC 8573, 4, 17.8–31.4 mm SL, paratypes, Brazil, Rondônia, Rio Guaporé basin.

Hyphessobrycon metae: ZUEC 14559, 5, 25.3–29.0 mm SL, Colombia, Meta, Río Meta basin.

Hyphessobrycon mutabilis: LBP 16034, 30, 18.7–25.9 mm SL, ZUEC 17131, 5, 21.5–27.3 mm SL, Brazil, Mato Grosso, Rio Culue basin.

Hyphessobrycon peruvianus: ZUEC 8659, 1, 27.1 mm SL, Peru, Loreto, Río Itaya basin; ZUEC 15477, 4, 26.3–30.5 mm SL, ZUEC 15497, 1, 29.3 mm SL, Brazil, Amazonas, Rio Javari basin.

Hyphessobrycon vanzolinii: ZUEC 12599, 2, 23.1–26.6 mm SL, ZUEC 12600, 1, 24.7 mm SL, paratypes, Brazil, Pará, Rio Tapajós.

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