

Original article

Redescription of *Hyphessobrycon itaparicensis*, a senior synonym of *H. sergipanus* (Characiformes: Characidae)

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Hyphessobrycon itaparicensis was originally described from a small stream in the Itaparica coastal island, Bahia State, Brazil, and has been sampled in several coastal rivers draining Bahia and Sergipe States. Broad examination of type material and recently collected specimens resulted in the redescription provided herein. The presence of one humeral blotch, absence of pseudotympanum, and conservation aspects of *H. itaparicensis* are briefly discussed. Data obtained from the original description, paratypes and topotypes of *H. sergipanus* showed broad overlap with *H. itaparicensis* and absence of morphological diagnostic features supporting the recognition of *H. sergipanus* as a valid species. Thus, *H. sergipanus* is considered as junior synonym of *H. itaparicensis*. We emphasize the need of examining large population samples and type material of similar congeners to avoid improper propositions of new specific names.

Keywords: Coastal Brazilian rivers, *Hyphessobrycon ellisae*, Intraspecific variation, Northeastern Mata Atlântica ecoregion, Sexual dimorphism.

Hyphessobrycon itaparicensis foi descrita de um pequeno riacho na Ilha de Itaparica, Estado da Bahia, Brasil, e tem sido amostrada em outros rios costeiros nos estados da Bahia e Sergipe. Um amplo exame do material tipo e exemplares recentemente coletados resultou na redescritção aqui apresentada. A presença de uma mancha umeral, a ausência de pseudotímpano e aspectos da conservação de *H. itaparicensis* são brevemente discutidos. Dados obtidos da descrição original, de parátipos e topótipos de *H. sergipanus* revelaram ampla sobreposição com *H. itaparicensis* e ausência de características morfológicas diagnósticas que sustentem o reconhecimento de *H. sergipanus* como espécie válida. Assim, *H. sergipanus* é considerada sinônimo júnior de *H. itaparicensis*. Nós enfatizamos a necessidade de examinar grandes amostras das populações e do material tipo de congêneres semelhantes para evitar a proposição indevida de nomes novos de espécies.

Palavras-chave: Dimorfismo sexual, Ecorregião Mata Atlântica Nordeste, *Hyphessobrycon ellisae*, Rios costeiros brasileiros, Variação intra-específica.

Introduction

Hyphessobrycon itaparicensis Lima & Costa was described in 2001 based on specimens sampled in 1994 in a small stream in the Ilha de Itaparica, a continental island in the Baía de Todos os Santos¹, near Salvador, Bahia State, in northeastern Brazil (Lima, Costa, 2001). Until recently, the species was only known from its type locality, which is currently buried by a series of real estate enterprises performed in the last two decades. The first record of the species elsewhere its type locality was published by Burger *et al.* (2011), expanding its occurrence to small coastal drainages at southern portions of Itaparica

island, reaching the proximities of Camamu municipality, in Bahia State. More recently, Brito *et al.* (2014) and Camelier, Zanata (2014) recorded *H. itaparicensis* further north, in rio Real (a coastal drainage on the border between Bahia and Sergipe States), and in rio Piauí and rio Sergipe (two coastal basins draining Sergipe State), indicating an apparently disjunct distribution. Posteriorly, Bragança *et al.* (2015) described *H. ellisae*, remarkably similar to *H. itaparicensis* from the rio Piauí (Brito *et al.*, 2014). However, the combination *Hyphessobrycon ellisae* had already been used by Pearson (1924) for a species from the Amazon basin, and it was then replaced by *H. sergipanus* Bragança *et al.* (Bragança *et al.*, 2016).

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The original description of *Hyphessobrycon itaparicensis* is based on a restricted population from the Ilha de Itaparica and does not encompass the intraspecific variation along its currently known distribution. The recently described *H. sergipanus* is remarkable similar to *H. itaparicensis* and its taxonomic validity doubtful. Aiming to clarify the taxonomic status of this Atlantic Forest fish species, a redescription of *H. itaparicensis* based on the examination of the type material and recently collected specimens along the Northeastern Mata Atlântica freshwater ecoregion is herein provided.

Material and Methods

Counts and measurements were taken according to Fink, Weitzman (1974) and Menezes, Weitzman (1990). In Tab. 1, standard length (SL) is expressed in mm and all other measurements are expressed as a percentage of SL, except subunits of the head that are expressed as percentages of the head length. Meristic data are given in the description, an asterisk indicates counts of the holotype, and the frequency of each count is given in parentheses. Counts of vertebrae, supraneurals, procurent caudal-fin rays, branchiostegal rays, gill-rakers, and dentary teeth were taken only from cleared and stained specimens (c&s), prepared according to Taylor, Van Dyke (1985). In the number of vertebrae the Weberian apparatus was counted as four elements and the fused first preural and first ural centrum of the caudal region was counted as a single element. Precaudal vertebrae include the Weberian apparatus and the vertebrae associated with ribs or haemal arches without haemal spines. Caudal vertebrae are vertebra associated with haemal spines. Pattern of *circuli* and *radii* was examined on scales sampled from the region between the lateral line and the origin of the dorsal fin. Institutional abbreviations follow Fricke, Eschmeyer (2017), with inclusion the of the Coleção Ictiológica da Universidade Federal de Sergipe (CIUFS). Catalog numbers are followed by the total number of specimens in alcohol, number of specimens measured and counted in parentheses (when distinct), SL range of all specimens of the lot, and if any, the number of c&s specimens and their SL range and/or the presence of samples of tissue from specimens directly preserved in alcohol for molecular studies (mol). Lots not used to obtain measurements and counts are indicated with an asterisk.

Results

Hyphessobrycon itaparicensis Lima & Costa, 2001

Figs. 1-4, Tab. 1

Hyphessobrycon itaparicensis Lima & Costa, 2001: 233-234; 236-237. Type locality: small stream in Ilha de Itaparica. -Lima *et al.*, 2003: 139 (list of species). -Buckup *et al.*, 2007: 54 (list of species). -Menezes *et al.*, 2007: 90 (list of

species). -Zanata, Camelier, 2010: 771-772; 776 (diagnosis of *H. brumado*; comparative material). -García-Alzate *et al.*, 2010: 58; 62 (diagnosis and comparison with *H. sebastiani*) -Burger *et al.*, 2011: 274; 277; 279; 282; 285; 290 (occurrence of species on the Recôncavo Sul basin, Bahia State; photo; identification key; comparative material). -Carvalho, Langeani, 2013: 533 (comparative material). -Menezes *et al.*, 2013: 29 (comments about conservation of type locality). -Brito *et al.*, 2014: 1156-1159 (geographic distribution; photos; molecular identification). -Camelier, Zanata, 2014: 687; 690; 691; 692; 696 (list of species; geographic distribution; comments). -Dagosta *et al.*, 2014: 373 (comparative material). -Carvalho *et al.*, 2014: 248 (diagnosis of *H. flammeus*). -Lima *et al.*, 2014: 170 (diagnosis of *H. montagi*). -Vieira *et al.*, 2016: 57-60 (description of pelvic- and anal-fins bony hooks; examined material).

Hyphessobrycon cf. *itaparicensis*. -Costa, 2004: 6 (habitat notes). *Hyphessobrycon ellisae* Bragança, Ottoni & Rangel-Pereira, 2015: 256 (original description, type locality: Brazil, Sergipe State, Município de Estância, about 8 km north of Santa Cruz do Abais). Preoccupied by *H. ellisae* (Pearson, 1924) and replaced by *Hyphessobrycon sergipanus* (Bragança *et al.*, 2016). *Hyphessobrycon sergipanus* Bragança, Ottoni & Rangel-Pereira, 2016: 373 (name replacement for *H. ellisae*). NEW SYNONYM.

Diagnosis. *Hyphessobrycon itaparicensis* can be easily distinguished from most congeners, except the species of the “rosy tetra clade” *sensu* Weitzman, Palmer (1997), and *H. balbus* Myers, *H. bifasciatus* Ellis, *H. chocoensis* García-Alzate, Román-Valencia & Taphorn, *H. columbianus* Zarske & Géry, *H. eilyos* Lima & Moreira, *H. flammeus* Myers, *H. gracilior* Géry, *H. griemi* Hoedeman, *H. igneus* Miquelarena, Menni, López & Casciotta, *H. panamensis* Durbin, *H. savagei* Bussing, *H. scutulatus* Lucena, *H. sebastiani* García-Alzate, Román-Valencia & Taphorn, *H. taguae* García-Alzate, Román-Valencia & Taphorn, *H. tortuguerae* Böhlke, and *H. weitzmanorum* Lima & Moreira, by the absence of any concentration of dark chromatophores at the caudal-peduncle region (*vs.* presence of a dark blotch or a longitudinal dark stripe extending over the caudal-peduncle region). Among the “rosy tetra clade”, *H. itaparicensis* differs from *H. axelrodi* (Travassos), *H. bentosi* Durbin, *H. compressus* (Meek), *H. copelandi* Durbin, *H. dorsalis* Zarske, *H. epicharis* Weitzman & Palmer, *H. eques* (Steindachner), *H. erythrostigma* (Fowler), *H. georgettae* Géry, *H. haraldschultzi* Travassos, *H. heteresthes* Ulrey, *H. jackrobertsi* Zarske, *H. khardinae* Zarske, *H. megalopterus* (Eigenmann), *H. micropterus* (Eigenmann), *H. minor* Durbin, *H. pando* Hein, *H. pyrrhonotus* Burgess, *H. rosaceus* Durbin, *H. roseus* (Géry), *H. simulatus* (Géry), *H. socolofi* Weitzman, *H. sweglesii* (Géry), and *H. takasei* Géry by the absence of a black dorsal-fin blotch (*vs.* presence). The species can be diagnosed from *H. bifasciatus*, *H. flammeus*, *H. griemi*, *H. savagei*, *H. sebastiani*, *H. tortuguerae*, and *H. weitzmanorum* by the

absence of a conspicuous second humeral blotch, having instead an inconspicuous concentration of melanophores without defined limits, that initiates immediately posterior to a clear area on the rear of the first humeral blotch and fades posteriorly (vs. second humeral blotch as conspicuous as first humeral blotch). The species can be further distinguished from some aforementioned species by presence of 3-11 maxillary teeth (vs. 1-2 in *H. bifasciatus*, *H. balbus*, *H. igneus*, and *H. ecuadoriensis*, and 2 in *H. chocoensis* and *H. sebastiani*), 5-8 pored scales on lateral line (vs. 9-13 in *H. columbianus*, and 10-13 in *H. savagei*),

presence of humeral blotch (vs. absence in *H. eilyos*, *H. gracilior*, and *H. scutulatus*), caudal fin hyaline (vs. caudal fin with black median stripe in *H. weitzmanorum*), 32-36 longitudinal scales series and vertically elongated humeral blotch (vs. 29-31 longitudinal scales series and rounded humeral blotch in *H. taguae*), and maxillary teeth tricuspid (vs. pentacuspoid teeth in *H. panamensis*). When alive, *H. itaparicensis* can be diagnosed from most congeners by usually having yellowish body and fins, allied to a dark brown or reddish midlateral stripe extending from dorsal-fin base to caudal peduncle.

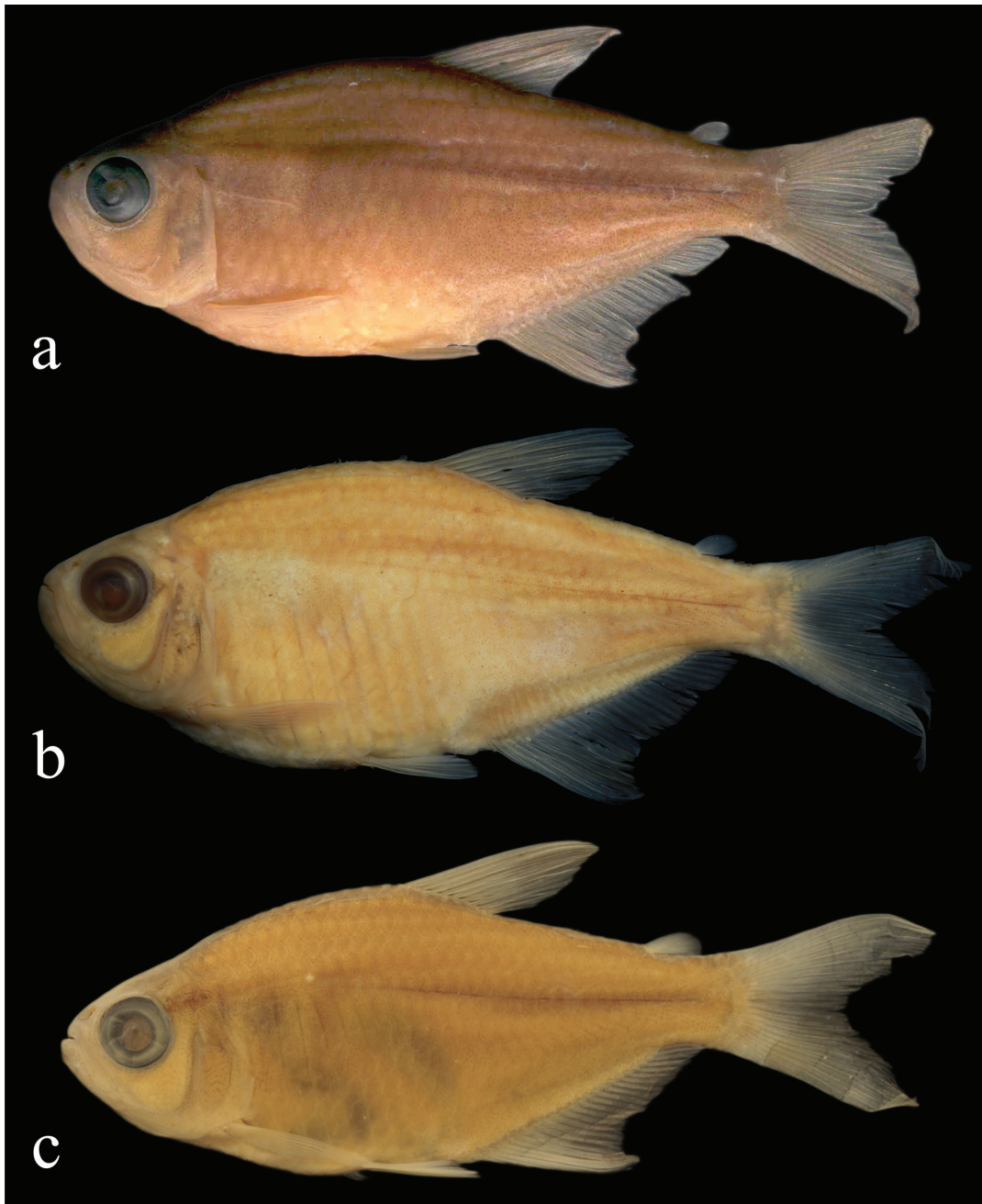


Fig. 1. *Hyphessobrycon itaparicensis*, all from Brazil, Bahia State, small stream in the Ilha de Itaparica: (a) MZUSP 57539, 38.4 mm SL, holotype in the original description (photo in 2001); (b) holotype (photo in 2015); and (c) UFBA 7553, 24.8 mm SL, stream on road between BA-001 and Ponta Grossa.

Tab. 1. Morphometric data of *Hyphessobrycon itaparicensis* (n =108), including holotype, 16 paratypes, and 91 non-type specimens; and *H. sergipanus* (n=11), including holotype (obtained from Bragança *et al.*, 2015) and 10 examined paratypes. Ranges of *H. sergipanus* do not include holotype. SD = standard deviation. Asterisk in percents of head length of *H. sergipanus* indicates the exact numbers given in the original description, with possible erroneous measurement of the upper jaw length.

	<i>H. itaparicensis</i>					<i>H. sergipanus</i>			
	Holotype	Paratypes	Non-types			Holotype	Paratypes		
		Range	Range	Mean	SD		Range	Mean	SD
Standard length (mm)	38.0	20.5-33.5	12.4-45.0	25.4	-	16.8	13.5-21.0	16.2	-
Percents of standard length									
Depth at dorsal-fin origin	40.0	32.9-41.3	31.7-44.7	37.2	2.3	36.9	32.1-35.9	34.3	1.6
Snout to dorsal-fin origin	55.0	50.7-55.5	50.7-55.9	54.1	1.6	55.5	53.2-58.2	54.9	1.5
Snout to pectoral-fin origin	27.1	26.7-29.5	26.5-31.6	28.8	1.1	30.4	27.7-31.8	29.6	1.2
Snout to pelvic-fin origin	48.7	45.9-49.2	43.5-51.2	47.3	1.6	46.9	43.8-47.7	46.1	1.3
Snout to anal-fin origin	64.7	60.0-65.8	57.8-65.5	61.9	1.9	58.1	55.8-61.5	58.6	1.6
Caudal peduncle depth	11.6	10.2-13.5	9.8-13.3	11.7	0.8	10.6	10.6-12.8	11.7	0.7
Caudal peduncle length	13.2	11.6-13.5	8.4-13.8	11.2	1.5	11.9	11.5-13.3	12.5	0.7
Pectoral-fin length	20.8	19.3-22.4	17.5-24.1	21.1	1.4	19.7	16.4-20.0	18.8	1.1
Pelvic-fin length	17.1	15.1-18.9	15.2-19.8	17.3	1.1	18.5	14.6-17.3	16.0	0.9
Dorsal-fin base length	12.6	10.8-13.7	11.1-15.2	13.2	1.0	15.7	12.6-15.5	14.4	1.0
Dorsal-fin height	27.1	26.9-29.9	23.1-32.6	28.1	1.6	28.6	25.1-29.2	27.3	1.2
Anal-fin base length	28.9	28.3-32.9	28.3-35.7	32.4	1.7	36.4	31.6-34.0	33.2	0.8
Anal-fin lobe length	20.3	20.1-24.0	17.3-26.2	22.2	1.6	-	20.5-23.8	22.4	1.3
Eye to dorsal-fin origin	41.6	36.1-40.6	36.3-42.1	39.4	1.3	39.4	37.1-39.4	38.4	0.8
Dorsal-fin origin to caudal-fin base	49.5	47.1-52.6	47.2-55.3	50.7	1.5	51.8	48.1-52.2	50.2	1.6
Head length	25.5	26.2-27.6	24.2-30.7	27.7	1.1	34.0	28.5-30.3	28.5	1.6
Percents of head length									
Horizontal eye diameter	36.1	36.1-40.3	36.1-44.8	40.0	2.2	40*	40.6-45.8	43.5	1.6
Snout length	24.7	19.4-23.2	16.1-25.8	21.8	1.8	21*	18.6-22.1	20.1	1.1
Least interorbital width	36.1	26.8-35.7	27.1-36.5	33.6	1.6	31*	29.0-33.7	31.3	1.6
Upper jaw length	46.4	40.9-47.7	40.0-49.5	45.5	2.3	6*	34.6-40.3	37.6	1.7

Description. Morphometric data are summarized in Tab. 1. Body somewhat compressed and elongate. Greatest body depth at vertical through dorsal-fin origin or slightly ahead of this point. Dorsal profile of head somewhat convex from upper lip to vertical through anterior nostrils; straight to slightly convex above eye and somewhat concave from the vertical through posterior border of eye and to tip of supraoccipital spine. Dorsal profile of body somewhat convex from tip of occipital spine to dorsal-fin origin; straight to somewhat convex and posteroventrally slanted along dorsal-fin base; straight from end of dorsal-fin base to adipose fin and slightly concave along caudal peduncle. Head rounded anteriorly in lateral profile. Ventral profile of head and body convex from lower lip to pelvic-fin origin; straight from that point to anal-fin origin; straight and posterodorsally slanted along anal-fin base, and slightly concave along ventral profile of caudal peduncle.

Eyes relatively large compared with head length. Lower jaw slightly longer than upper jaw, mouth terminal. Posterior terminus of maxilla usually extending beyond vertical through anterior margin of orbit. Nostrils close to each other and separated by skin flap; anterior opening small, semicircular and with dermal flap; posterior one

more than twice in size, elongate and without dermal flap. Nasal bone present. Frontals separated anteriorly, with wide fontanel; parietal fontanel large, extending from epiphyseal bar to supraoccipital spine, slightly narrowed anteriorly. Infraorbital series variable; usually six elements but only five elements are present in some specimens, possibly due to fusion of infraorbitals three with four (*e.g.*, UFBA 7553, 27.4 mm SL). Third infraorbital largest and contacting laterosensory canal of preopercle ventrolaterally. Laterosensory canal of first infraorbital absent; canal present and close to inner margin of orbital rim from second to fourth infraorbitals. Degree of development of the parietal branch of the supraorbital canal variable, reaching parietal bone (UFBA 7558), just reaching suture between frontal and parietal bones (CIUFS 426, 38.9 mm SL; UFBA 7553, 27.4 mm SL), or poorly developed, not reaching the suture between frontal and parietal bones (CIUFS 694, 21.9 mm SL; UFBA 7515, 19.0 mm SL).

Premaxillary teeth in two rows; outer row with one (2), two* (46) or three (52) teeth bearing three cusps; inner row with four (1), five* (74), six (24), or seven (1) teeth bearing three to five cusps; symphyseal tooth of inner series narrow, asymmetrical, usually without cusp on anteromedial

side, one larger central cusp and one smaller on lateral side; second or third tooth the largest, with three or five cusps; last teeth smaller with three cusps or conical. Maxilla with three* (11), four (25), five (16), six (26), seven (12), eight (2), nine (4), or 11(1) teeth; anterior ones usually with three cusps and posterior ones conical. Dentary with 11(1), 12(5), 14(2), 15(2), 16(1), or 19(1) teeth; four or five large anterior teeth cusps with three in most specimens examined, but specimens around 37.0 mm SL or larger with anterior teeth pentacuspoid; seven to 14 smaller posterior teeth, usually conical (Fig. 2).

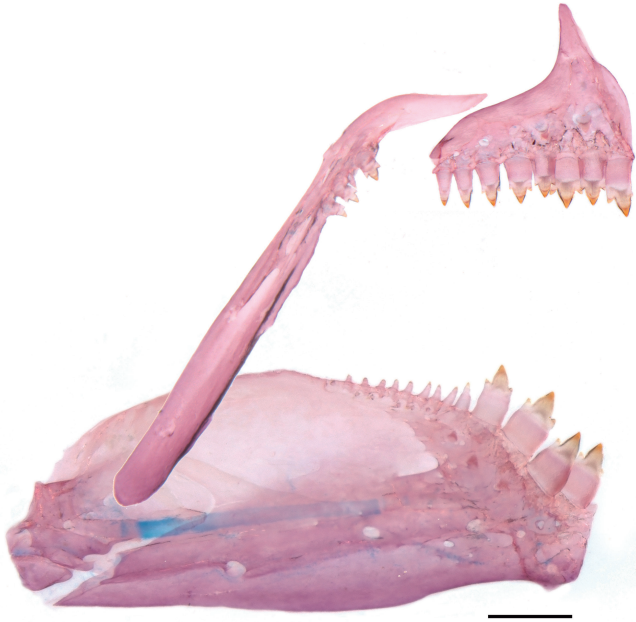


Fig. 2. Medial view of left side of upper and lower jaws of *Hyphessobrycon itaparicensis*, UFBA 7515, male, 27.5 mm SL, Brazil, Bahia, Ilha de Itaparica. Scale bar = 0.5 mm.

Scales cycloid, *circuli* absent on exposed area of scales, with several parallel *radii* extending to posterior margin of scale. Lateral line incomplete; with five (3), six* (38), seven (42), or eight (10) pored scales; longitudinal scales series including pored scales 32(1), 33(10), 34(22), 35(19), or 36(3). Some scales lost in the holotype. Horizontal scale rows between dorsal-fin origin and pelvic-fin insertion 12*(14) or 13(78), commonly six above and six below lateral line, and more rarely seven above and six below. Scales along middorsal line between tip of supraoccipital process and origin of dorsal fin 10*(36), 11(35), or 12(9). Horizontal scale rows around caudal peduncle 13*(5) or 14(53). Base of anteriormost anal-fin rays covered by a series of three to five scales. Caudal fin with scales restricted to the base of rays. Muscular reduction at vertical through anterior portion of the swimbladder; swimbladder not completely exposed but covered by a thin layer of musculature; muscular reduction between first and second pleural ribs, visible or not by transparency through the body wall as a deep dark area under the humeral blotch.

Dorsal-fin rays ii,8(3), ii,8,i(6), ii,9*(82), iii,9(4), ii,10(7). Distal margin of dorsal fin straight or slightly rounded. Dorsal-fin origin situated at vertical through approximately middle of standard length. Base of last dorsal-fin ray anterior to vertical through anal-fin origin. First dorsal-fin pterygiophore inserting behind neural spine of 10th (8) vertebra. Adipose fin present. Anal-fin rays unbranched rays iii*(24), iv(70) or v(1); branched rays 20(2), 21(19), 22(24), 23*(28), 24(17), 25(7), or 26(1). Distal margin of anal fin slightly concave. First anal-fin pterygiophore inserting behind haemal spine of 15th(4) or 16th(4) vertebra. Pectoral-fin rays i,9(11), i,9,ii(3), i,10(46), i,10,i(1), i,11*(36), or i,12(5). Tip of pectoral fin usually reaching or slightly surpassing vertical through pelvic-fin insertion. Pelvic-fin rays i,5(1), i,6*(102), or i,7(2); tip of pelvic fin of mature males usually extends beyond insertion of first anal-fin ray. Caudal fin forked, lobes pointed, similar in size. Principal caudal-fin rays i,9+8,i(11). Eight (4), nine (4), 10(1), or 11(1) dorsal procurrent caudal-fin rays, and eight (7) or nine (3) ventral procurrent caudal-fin rays. First gill arch with five (4), six (3), or seven (1) gill rakers on epibranchial, eight (2) or nine (6) on hypobranchial and ceratobranchial, and one (8) on cartilage between ceratobranchial and epibranchial. Precaudal vertebrae 13(2), 14(7), or 15(2) and caudal vertebrae 19(1), 20(6), 21(3), or 22(1); total vertebrae 33(1), 34(8), 35(1), or 37(1). Supraneurals four (2), five (6), or six (2). Branchiostegal rays four (11).

Coloration in alcohol. Overall ground color yellow to light brown (Fig. 1). Guanine restricted to part of infraorbitals, preopercle, and opercle in somewhat recently fixed specimens. Dorsal part of head with melanophores sparsely and evenly distributed, usually darker posterior to eyes. Melanophores sparsely distributed over maxilla and lateral portion of head, larger posterior to eyes. Opercle with sparse melanophores, usually more concentrated on its dorsal half. Ventral portion of head with a few scattered small melanophores, more concentrated on anteriormost portion. Dorsum and scales along lateral of body with sparse melanophores; middorsal series usually homogeneously darkened; two or three dorsalmost series of scales with clearer posterior border. Scales below it with melanophores homogeneously distributed. Abdominal region clear or with sparse tiny melanophores. Humeral region with a vertically-elongated faint humeral blotch, wider dorsally and tapering ventrally; widest portion located on second horizontal series above lateral line, reaching three or four scales horizontally. Humeral blotch preceded and followed by clear areas, although clear areas not completely devoid of melanophores; blotch formed by superficial melanophores. Some specimens, usually about 33.0 mm SL or larger, with concentration of melanophores posterior to the clear area on the rear of the humeral blotch, but not characterizing a well-defined second blotch (see item Discussion). Midlateral black narrow stripe along

horizontal septum from vertical through dorsal-fin origin to caudal peduncle, more evident in the stretch posterior to the dorsal-fin origin, but falling short of the end of caudal peduncle; dark line or stripe formed by melanophores over skin and also embedded dark pigmentation; largest specimens (about 37.0 mm SL or larger) with longitudinal stripe slightly wider and less conspicuous. No distinct caudal-peduncle blotch or/and stripe. All fins slightly darkened; dorsal, caudal, and pectoral usually with tiny melanophores forming dark lines along borders of rays and sparse melanophores on interradiation membranes. Anal fin similarly colored, but lacking dark lines on borders of rays; distal border of fin somewhat darker, more evident on anteriormost rays. Pelvic fin somewhat less colored, with melanophores usually restricted to distal portion of rays; some specimens with distal half of rays distinctly dark. Adipose fin mostly hyaline; some specimens with few scattered small melanophores at base of fin. Specimens sampled in black water streams usually with overall darker coloration of body and fins, rendering some patterns and blotches described above somewhat merged with ground coloration and inconspicuous.

Coloration in life. Life color pattern is somewhat variable along distribution and apparently influenced by the physical characteristics of water body inhabited by each population (Fig. 3). Specimens from clear water rivers usually possess yellowish overall body coloration, including distinct yellow coloration of fins, maxillae, and dorsal half of head (Figs. 3a, c-e). Additionally, a brown-reddish longitudinal stripe, from the rear of the humeral blotch or body midlength to the caudal peduncle is observed in some of those specimens (Fig. 3d). On the other hand, specimens from dark waters are more pigmented, with no humeral blotch or clear surrounding areas visible (Fig. 3b). These specimens are usually shiny silver, with large amount of guanine over scales on flank and dark longitudinal stripe, when visible. They possess yellow or orange chromatophores over scales on anterior half of body and strong yellow to orange fins.

Sexual dimorphism. Lima, Costa (2001: 235) mentioned “no hooks on fins” of *H. itaparicensis*. However, Brito *et al.* (2014) and Vieira *et al.* (2016) recently reported the presence of bony processes on anal and pelvic fins in *H. itaparicensis* specimens from rivers draining Sergipe State. Examination of paratypes of *H. itaparicensis* (MZUSP 57540, UFRJ 4843) and various recently sampled specimens also revealed well-developed bony processes on first to fourth branched anal-fin rays and on the anteriormost two or three branched pelvic-fin rays (Fig. 4). Anal-fin bifurcated bony processes are distributed from the last unbranched up to the eighth branched anal-fin rays, usually on distal half of rays, on the segment just before the bifurcation of rays and continuing on dorsal hemitrichium of each ray. Bony processes are concave, anterodorsally directed bilaterally, symmetric, larger around midlength

of branched portion of rays (Fig. 4a), and usually more numerous in the third and fourth branched anal-fin rays, with up to 12 paired processes (UFBA 7558, 40.5 mm SL). Pelvic-fin rays have similar concave and anterodorsally directed bony processes on the first and second, rarely on third, branched rays of mature males (Fig. 4b; see also Brito *et al.* (2014: 1159, Fig. 5d). However, pelvic-fin bony processes are not bifurcate and are distributed on the border of three or four segments anterior to branching point or restricted to the dorsal hemitrichium. Bony processes decrease in size on distal portion of rays. Up to 15 bony processes were observed in the first and 13 processes on the second branched ray (UFBA 7558, 40.5 mm SL). In one paratype (MZUSP 57540, 25.4 mm SL), six processes were observed in each of the two first branched rays and in another paratype (UFRJ 4843, 32.0 mm SL), processes occur on three first branched rays.

Other sexually dimorphic traits observed in *H. itaparicensis* include interradiation membrane on areas with bony processes on both fins tumescent, shape of the anal-fin profile distinct in males and females, and pelvic-fin length distinct in males and females. According to Brito *et al.* (2014: 1159, Figs. 5a-b) the anal-fin distal profile is almost straight in males vs. concave from fifth to tenth branched ray in females. Examination of mature males performed herein corroborates this information, although with some variation among populations examined. Brito *et al.* (2014) described the distal end of the pelvic fin surpassing the anal-fin origin in males but not reaching the anal fin in females. However, examination of paratypes (UFRJ 4843, 32.0) revealed pelvic fin of females reaching the anal-fin origin and non-type mature males with pelvic fin barely reaching anal-fin base (UFBA 7558, 40.5 mm SL). Males usually have tips of pelvic-fin rays reaching beyond the anal-fin origin and overlapping the base of the first branched fin rays, while in females the pelvic fin may reach the anal fin but does not reach the basal portion of the branched fin rays. The holotype is apparently a female, relatively large-sized, without bony processes on fin rays, with concave anal-fin profile, and pectoral-fin barely reaching pelvic-fin insertion. Distinct elongation of fins in males and sexually dimorphic coloration typical of various species of *Hyphessobrycon* were not observed in *H. itaparicensis*. Gill glands (Burns, Weitzman, 1996) were not found on first gill arch of neither sex.

Geographic distribution. *Hyphessobrycon itaparicensis* occurs in small coastal Brazilian rivers in the Northeastern Mata Atlântica freshwater ecoregion (NMAF), from streams around Camamu municipality, Bahia State in its southernmost distribution, to tributaries of rio Sergipe in Areia Branca municipality, Sergipe State, up north (Fig. 5). The known distribution of this species is restricted to a group of basins proposed by Camelier, Zanata (2014), the ‘Group North’, which includes drainages situated in the northernmost portion of the NMAF ecoregion.

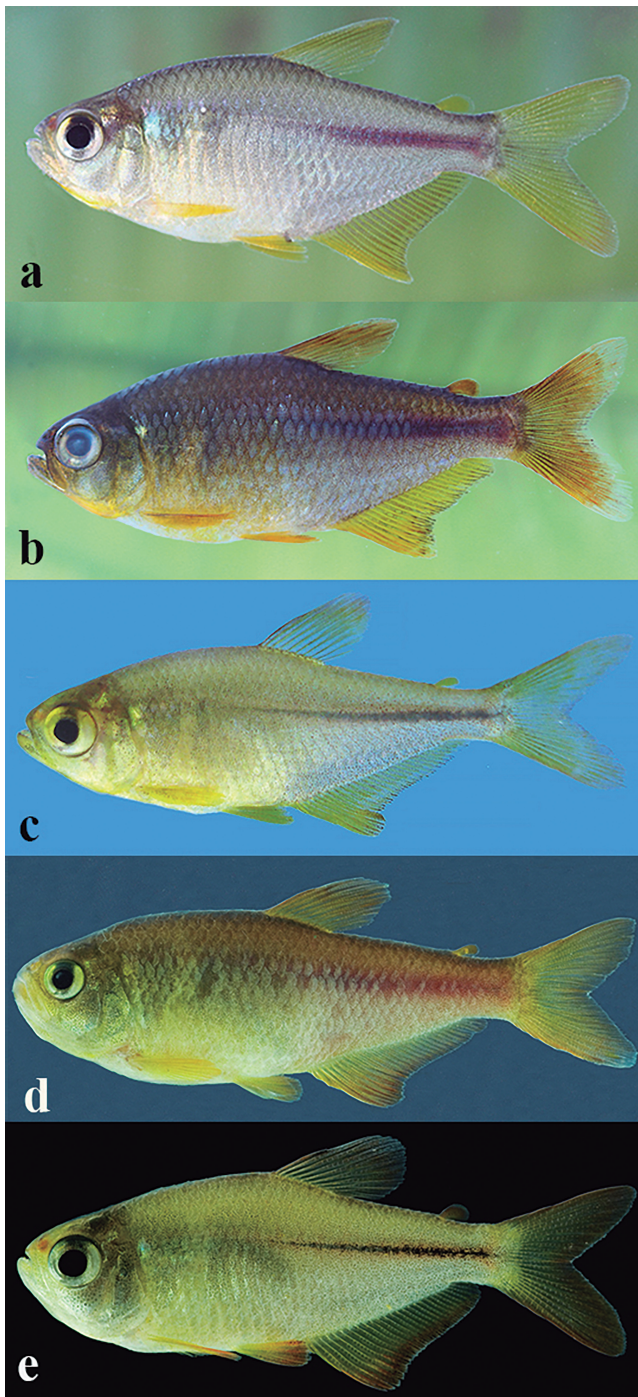


Fig. 3. Live specimens of *Hyphessobrycon itaparicensis*, all from Brazil: (a) UFBA 7553, 22.7 mm SL, Bahia, Ilha de Itaparica, stream on road between BA-001 and Ponta Grossa; (b) UFBA 7558, 46.7 mm SL, Bahia, Cairu, stream between Cairu and Torrinhas; (c) UFBA 5454, 25.8 mm SL, Bahia, Entre Rios, stream tributary of rio Sauípe basin; (d) UFRN 207, 24.3 mm SL, Sergipe, Estância, Areia Branca, tributary of rio Fundo, rio Piauí basin (same river basin of the type material of *H. sergipanus*); and (e) CIUFS 458, 43.0 mm SL, Sergipe, rio Poxim, rio Sergipe basin. Photos “d” and “e” sent by Marcelo Brito (same presented by Brito *et al.*, 2014: fig. 1).

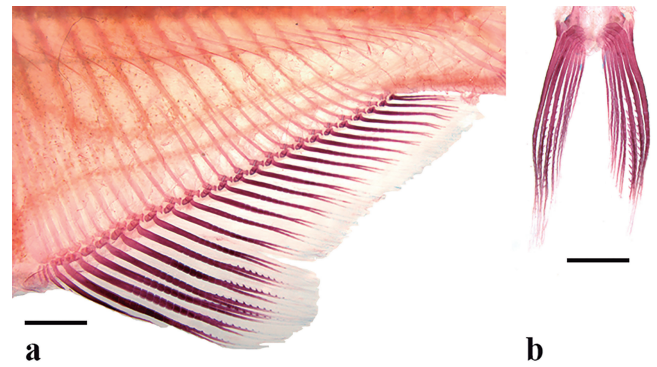


Fig. 4. *Hyphessobrycon itaparicensis*, UFBA 7558, male, 39.1 mm SL: (a) anal and (b) pelvic fins indicating bony processes. Scale bars = 2 mm.

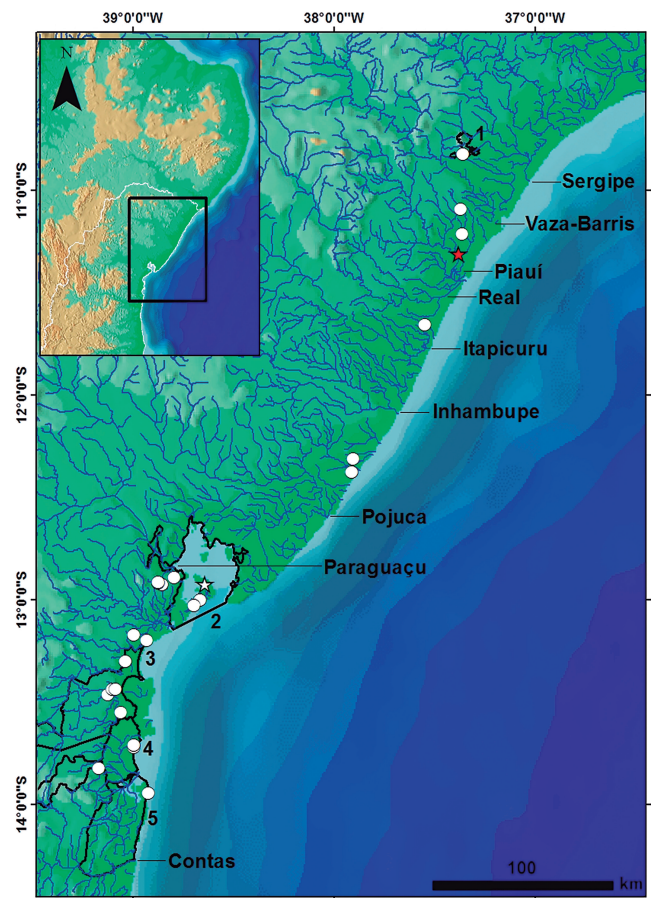


Fig. 5. Distribution map of *Hyphessobrycon itaparicensis*. White and red stars represent the type localities of *H. itaparicensis* and *H. sergipanus*, respectively. Some circles indicate more than one sampling site. Names of the main drainages of the Northeastern Mata Atlântica ecoregion are given. Numbers refer to conservation units (1) Itabaiana National Park, (2) Baía de Todos os Santos Environmental Protection Area (EPA), (3) Caminhos Ecológicos da Boa Esperança EPA, (4) Pratigi EPA and (5) Baía de Camamu EPA.

Ecological notes. *Hyphessobrycon itaparicensis* was first sampled in a small clear water stream (about 4 m wide and 1

m deep) below a small waterfall in Ilha de Itaparica, located about 200 m from the sea, although without tidal influence (Lima, Costa, 2001), in Barra do Gil, municipality of Vera Cruz (C. Sampaio, person. comun.), on the eastern portion of the island. According to the original description, no syntopic fish species was found on that occasion. Sampling efforts performed since 2004 in rivers draining Bahia and Sergipe States revealed the occurrence of the species in several small slow water coastal streams, exclusively in remnants of Atlantic Forest. According to Brito *et al.* (2014: see fig. 3), in the lower portion of Piauí and Sergipe river basins, the species inhabits small and shallow streams, with variable substrate, lentic areas alternating with lotic stretches, and acid blackwaters with pH 5.3-5.7. In the present study, the species was sampled in clear (Fig. 6a) and blackwater streams (Fig. 6b), although predominantly in the former. The locations sampled are mainly sandy or muddy bottomed, usually with organic debris, up to 2 m deep and 10 m wide. They are surrounded mainly by shrubs and trees, with grass and palm trees (*Elaeis guineensis* Jacq.) dominant in certain locations. Aquatic plants (e.g., *Juncus* sp., *Montrichardia linifera* (Arruda) Schott, *Nymphaea* sp.) are common where *H. itaparicensis* occurs. At Ilha de Itaparica, it was sampled in small lentic streams and pounds of blackwater, with temperature around of 26°C and pH 5.5. According to Brito *et al.* (2014), the species occurs in groups of 10-15 individuals in calm water and close to surface vegetation where they forage. Gut contents analysis provided by these authors revealed fragments of Arthropoda (Hemiptera, Coleoptera, Diptera, Hymenoptera, and Acari) and algae (Desmidiaceae). In addition, the analysis of stomach contents of two specimens of *H. itaparicensis* (UFBA 7515) also revealed the presence of organic debris, insect larvae, fragments of adults of terrestrial insects (Hymenoptera: Formicidae and other unidentified orders) and of other unidentified arthropods.

Among congeners, only *H. parvulus* Ellis occurs in sympatry with *H. itaparicensis*, and this co-occurrence is restricted to a few small basins on northernmost portion of the species distribution (rio Marcaná, rio Sauípe, rio Real, and rio Sergipe). According to Brito *et al.* (2014), in Sergipe State, *H. itaparicensis* is syntopic with *Astyanax* sp., *A. lacustris* (Lütken), *Callichthys callichthys* (Linnaeus), *Hoplerythrinus unitaeniatus* (Agassiz), *Hoplias malabaricus* (Bloch), and *Cichlasoma sanctifranciscense* Kullander. Other syntopic species in rivers draining Bahia State are *Characidium bahiense* Almeida, *Characidium* sp., *Geophagus* sp., *Mimagoniates sylvicola* Menezes & Weitzman, *Poecilia vivipara* Bloch & Schneider, *Prorivulus auriferus* Costa, Lima & Suzart, and *Scleromystax* sp.

Popular name. Piaba.

Conservation status. *Hyphessobrycon itaparicensis* was defined as 'Least Concern' (LC) in the Brazilian redlist (ICMBio, 2014). As given in the item Ecological Notes, *H.*

itaparicensis occurs exclusively in small coastal streams draining remnants of Atlantic Forest, a highly threatened biome and one of the two Brazilian hotspots (Myers *et al.*, 2000; Tabarelli *et al.*, 2005). The type locality of the species, a small island stream in the Ilha de Itaparica, has been destroyed by a series of real estate enterprises performed in the last two decades, but the species still occurs in small pools in the island. We herein define a somewhat continuous distribution of *H. itaparicensis*, from coastal rivers around the rio Contas, in the proximities of Camamu municipality (Bahia State) to rio Sergipe (Sergipe State), with exception of areas around Salvador and adjacent urban concentrations. As the species is abundant in streams to the south and to the north of Salvador, in dark acidic water streams surrounded at some degree by the remnants of the Atlantic Forest, we suggest that the distribution gap is due to intense urban occupation. The species is apparently dependent of the marginal vegetation, which provides shady water areas for successful protection and reproduction, and input of allochthonous food, especially small insects. Given that, deforestation apparently severely affects the occurrence of *H. itaparicensis*.



Fig. 6. Some localities where *Hyphessobrycon itaparicensis* occurs: (a) riacho do Macaco, tributary of rio Fundo, rio Piauí basin, Estância, Sergipe (clear water) and (b) stream next to Praia do Pratigi, Ituberá, Bahia (black water).

Hyphessobrycon itaparicensis was registered in five conservation units, one of integral protection, the Itabaiana National Park at its northernmost record, and four of sustainable use, Baía de Todos os Santos Environmental Protection Area (EPA), including the type locality, Caminhos Ecológicos da Boa Esperança EPA, Pratigi EPA and Baía de Camamu EPA, mainly in its southern distribution (Fig. 5). According to Brito *et al.* (2014), the areas of occurrence in Sergipe State are subjected to several anthropic impacts such as removal of native vegetation for planting of pasture and crops, elimination of wetlands, shrimp farming, sand extraction, and unplanned state development, a similar situation throughout the species distribution. Due to intense anthropic pressure on the streams of the Northeastern Mata Atlântica ecoregion, it is possible that important areas for the survival of the species will disappear and additional evolutionary and ecological studies should be conducted in order to better understand its biological aspects.

Discussion

Reexamination of the type material and specimens from extensive samples throughout the distribution of *Hyphessobrycon itaparicensis* revealed broad intraspecific variation in some characters and a few inconsistencies with information of the original description of the species. According to the original description, *H. itaparicensis* possesses seven longitudinal series of scales above lateral line and five below (see Lima, Costa, 2001: 235). However, the present analysis revealed six longitudinal series above (rarely seven) and six below the lateral line. Furthermore, *H. itaparicensis* was described as having 3-5 maxillary teeth (Lima, Costa, 2001: 235), but a range of 3-11 maxillary teeth occurs in the species, with majority of specimens having 4-6 teeth (67 of 97 specimens examined). Although with a gradual distribution of counts and broad overlap, a tendency of having lower number of teeth (3-5) in the southern portion of the species distribution, and, in opposition, an increase in the number of maxillary teeth to the north (6-11) is clear.

The presence of two faint humeral blotches was described as diagnostic to *Hyphessobrycon itaparicensis* (Lima, Costa, 2001: 235). Examination of a large number of specimens revealed that presence of melanophores concentrated posteriorly to the humeral blotch is intraspecifically variable in the species (Figs. 1, 3). Usually, a clear area on the rear of the humeral blotch is followed by a weak concentration of melanophores, with poorly defined posterior limits and not characterizing a distinct second humeral blotch (Figs. 1, 3c, e). However, some specimens possess a somewhat more defined concentration of melanophores, resembling a second poorly defined humeral blotch (Figs. 3a, b), and in others the concentration of melanophores is continuous with an also usually faint longitudinal stripe (Fig. 3d). Definition of a second humeral blotch have been discussed in the literature and cases somewhat similar to that of *H. itaparicensis* are treated as a "(...) pigmented area progressively fading

posteriorly as a longitudinal stripe" (e.g., Marinho, Birindelli, 2013; Marinho, Ohara, 2013; Marinho *et al.*, 2015) rather than as a second humeral blotch. Particularly to members of *Hyphessobrycon*, Teixeira *et al.* (2016) recognized the second humeral blotch as present only when it has well-defined anterior and posterior limits, as seen, for example, in *H. bifasciatus*, *H. flammeus*, and *H. griemi*. Thus, following the proposition of Teixeira *et al.* (2016), *H. itaparicensis* possesses a unique well defined humeral blotch. Examination of the type material revealed a faded coloration of the holotype with no humeral blotch visible at all (Fig. 1b). Among paratype specimens one humeral blotch is represented by a few remnant melanophores, with no posterior concentration of dark chromatophores.

Presence of a horizontal dark brownish crimson stripe on the posterior half of body side, when alive, was defined by Lima, Costa (2001: 235) as a diagnostic feature to *H. itaparicensis*. However, high variation on this character was observed throughout the populations examined. In fact, the presence of a reddish stripe is not common to the species and depends on the developmental stage and physical characteristics of the water. Relatively large specimens (around 40.0 mm SL) living in clear water streams may possess a reddish longitudinal stripe, along with a pale yellow coloration on body and fins. On the other hand, specimens from black and acid waters are overall darker, without longitudinal stripe and humeral blotch easily distinguishable. Furthermore, ontogenetic variation in body coloration apparently occurs, with darker and narrower midline stripe more conspicuous in specimens up to 37.0 mm SL (see item Sexual dimorphism) and stripe less evident in larger specimens.

Presence of a hiatus in the musculature covering anterior portion of the swimbladder, characterizing a pseudotympanum or just reduction of the musculature without hiatus, was previously discussed for a series of species of *Hyphessobrycon*, including *H. brumado* Zanata & Camelier, *H. negodagua* Lima & Gerhard, and *H. parvellus* (Lima, Gerhard, 2001; Zanata, Camelier, 2010; Dagosta *et al.*, 2014). *Hyphessobrycon itaparicensis* has a musculature reduction in the humeral region, with a thin layer of muscles in the area between the first and second pleural ribs. The condition of *H. itaparicensis* is not considered a "pseudotympanum", since there is no muscle hiatus (see Malabarba, 1998: 200). Among congeners, *H. brumado*, *H. negodagua*, *H. parvellus*, and *H. vinaceus* Bertaco, Malabarba & Dergam have similar condition, with musculature reduced to a thin layer, somewhat less reduced in *H. vinaceus*. A distinct "pseudotympanum", with a muscular hiatus and partial exposition of the first and second pleural ribs was observed only in *H. micropterus*.

***Hyphessobrycon sergipanus* as new synonym.** Bragança *et al.* (2015) described *Hyphessobrycon ellisae*, currently named as *H. sergipanus* (Bragança *et al.*, 2016), based on 24 small specimens (9.5-21.0 mm SL) from a unique stream

affluent of the rio Piauí, one of the drainages previously cited by Brito *et al.* (2014) to harbor *H. itaparicensis*. According to the original description, *H. sergipanus* distinguishes from *H. itaparicensis* by only three characters: outer premaxillary teeth always unicuspid (*vs.* tricuspid), anteriormost four dentary teeth with three cusps (*vs.* five cusps), and presence of bony processes on pelvic-fin rays of mature males (*vs.* absence) (Bragança *et al.*, 2015: 257, 258, and 260). The detailed comparison between the two species performed herein fails to demonstrate morphological differences between them. In the description of *H. sergipanus*, Bragança *et al.* (2015: 258) mentioned 2-3 exclusively unicuspid teeth in the outer premaxillary row. However, examination of 10 paratypes (UFRJ 5280, 13.5-21.0 mm SL) and two c&s topotypes of *H. sergipanus* (CIUFS 694, 19.7-21.3 mm SL) revealed frequent occurrence of tricuspid premaxillary outer teeth instead of unicuspid. Thus, the presence of tricuspid teeth in *H. sergipanus* is compatible with the condition described for *H. itaparicensis* and does not represent a diagnostic character. The second proposed diagnostic feature of *H. sergipanus* is the presence of three cusps on the largest dentary teeth instead of five cusps as *H. itaparicensis*. As noted above, the description of *H. sergipanus* was based in small specimens. Examination performed herein of similar sized specimens throughout the distribution of *H. itaparicensis* (e.g., UFBA 7553, 20.8-23.6 mm SL; UFBA 7558, 19.8 mm SL), revealed that dentary teeth composed either of uni- or tricuspid teeth are common conditions of small specimens of *H. itaparicensis*.

The information given by Bragança *et al.* (2015: 258) on the presence of bony processes on pelvic-fin rays of *H. sergipanus* and absence in *H. itaparicensis*, was apparently based solely in data of the original description of *H. itaparicensis*, which should be viewed with caution. Presence of bony processes on anal and pelvic fins of *H. itaparicensis* was recently described by Brito *et al.* (2014) in specimens from rivers draining Sergipe State, a condition confirmed in the present study and expanded for specimens throughout the distribution of *H. itaparicensis*. Thus, presence or absence of bony processes on the pelvic fin seems not useful to distinguish *H. sergipanus* and *H. itaparicensis*.

Therefore, as discussed above, it is clear that *H. sergipanus* cannot be unequivocally distinguished from *H. itaparicensis*. Thus, *H. sergipanus* is herein considered as junior synonym of *H. itaparicensis*. We strongly reiterate the proposition of Menezes *et al.* (2015) and Marinho *et al.* (2015) to examine large population samples of various sites, whenever possible.

Congeners in Northeastern Brazil. Twelve species of *Hyphessobrycon* are recorded in rivers draining northeastern Brazil, distributed between Bahia and Ceará States. Along with *H. itaparicensis*, four congeners were described from rivers draining Bahia: *H. brumado* from the upper rio de Contas basin, *H. negodagua* from the rio Paraguaçu, *H. parvellus* from the rio Catu and rio Itapicuru, and *H.*

vinaceus from the rio Pardo basin. As previously stated, only *H. parvellus* occurs in sympatry with *H. itaparicensis*, in a few small basins on the northernmost portions of the species distribution (rio Sauípe, rio Real, and rio Sergipe) (Brito *et al.*, 2014). Along with the distinctive body coloration, *H. itaparicensis* is easily distinguished from these congeners by having a humeral blotch (*vs.* absent in *H. brumado*, *H. negodagua*, and *H. parvellus*), absence of sexually dimorphic coloration (*vs.* present in *H. brumado*, *H. negodagua*, and *H. parvellus*), and higher number of maxillary teeth (3-11 *vs.* 0-3 in *H. brumado*, *H. negodagua*, and *H. parvellus*). *Hyphessobrycon itaparicensis* differs from *H. vinaceus* by having 5-8 perforated scales on lateral line (*vs.* 10-26), and absence of dark stripe on caudal peduncle and median caudal-fin rays (*vs.* presence).

The remaining northeastern congeners are somewhat more widespread or occur only outside of Bahia State: *Hyphessobrycon bifasciatus* may represent a species complex and occurs in various eastern Brazilian rivers including southern Bahia State, *H. diastatos* Dagosta *et al.* from the rio São Francisco and upper-middle rio Tocantins, *H. iheringi* Fowler, *H. latus* Fowler (species *inquirenda*), and *H. piabinhas* Fowler are known from Fortaleza, Ceará State, and *H. micropterus* and *H. santae* (Eigenmann) from the rio São Francisco basin. *Hyphessobrycon itaparicensis* further differs from these congeners by the absence of caudal blotch (*vs.* presence in *H. diastatos*, *H. iheringi*, *H. latus*, *H. micropterus*, *H. piabinhas*, and *H. santae*), presence of humeral blotch (*vs.* absence in *H. iheringi*, *H. latus*, and *H. piabinhas*), and higher number of maxillary teeth (3-11 *vs.* 0-2 in *H. bifasciatus*, *H. iheringi*, *H. latus*, *H. micropterus*, *H. piabinhas*, 1-3 in *H. diastatos*, and 3-5 in *H. santae*).

Material examined. Type specimens. *Hyphessobrycon itaparicensis*: MZUSP 57539, 38.4 mm SL, holotype. MZUSP 57540, 6, 20.4-25.8 mm SL, paratypes; UFRJ 4843, 10, 24.5-33.5 mm SL, paratypes. *Hyphessobrycon sergipanus*: UFRJ 5280, 10 of 17, 13.5-21.0 mm SL, paratypes. **Non-type specimens. Bahia.** MZUSP 112690, 13, 12.4-21.2 mm SL; MZUSP 115273, 2, 27.4-29.7 mm SL; UFBA 2687, 3(1), 15.2-19.6 mm SL; UFBA 2706, 5(1), 14.6-19.5 mm SL; UFBA 2768*, 2, 36.5-37.4 mm SL; UFBA 4618*, 2, 16.0-17.5 mm SL; UFBA 5134*, 4, 16.8-24.8 mm SL; UFBA 5454, 143(20), 12.4-21.8 mm SL; UFBA 5784, 13(2), 15.7-26.4 mm SL; UFBA 5878, 17, 13.1-22.3 mm SL; UFBA 6015, 12(2), 15.0-25.5 mm SL; UFBA 6056, 5(2), 21.1-27.1 mm SL; UFBA 6057, 3(2), 19.5-25.1 mm SL; UFBA 6058*, 7, 15.9-22.8 mm SL; UFBA 6272*, 9, 12.3-20.2 mm SL; UFBA 6287*, 6, 14.3-19.1 mm SL; UFBA 6294*, 1, 16.4 mm SL; UFBA 6302*, 25, 12.3-17.4 mm SL; UFBA 7007*, 11, 16.6-37.3 mm SL; UFBA 7269, 6(2), 19.6-26.4 mm SL; UFBA7320, 10, 14.5-21.2 mm SL; UFBA 7321, 23(2), 14.7-30.8 mm SL; UFBA 7324, 5, 14.9-21.7 mm SL; UFBA 7332, 4, 16.9-21.1mm SL; UFBA 7540*, 6, 14.2-16.7 mm SL; UFBA 7515, 21(2), 17.5-29.5 mm SL, 3 c&s; UFBA 7553, 13(3), 18.3-29.0 mm SL, 2 c&s; UFBA 7554, 24(3), 9.8-25.9 mm SL; UFBA 7556, 94(2), 13.0-28.3 mm SL; UFBA 7558, 28(6), 17.0-45.0 mm SL, 2 c&s; UFBA 7579, 37(2), 14.6-27.5 mm

SL; UFBA 7615, 7(1), 13.1-26.1 mm SL; UFBA 7667, 84, 9.8-30.3 mm SL; UFBA 7709, 2, 18.5-31.9 mm SL. **Sergipe.** CIUFS 445, 2, 30.8-39.4 mm SL; CIUFS 426, 2(1), 30.1-42.6 mm SL, 1 c&s; CIUFS 458, 1, 42.6 mm SL; CIUFS 486, 13(2), 27.8-31.6 mm SL; CIUFS 688, 15(3), 13.2-21.7 mm SL, 2 c&s; CIUFS 689, 36(6), 3 c&s, 17.6-23.7 mm SL; CIUFS 694, 2 c&s, 20.6-22.0 mm SL; UFBA 5453, 29(5), 13.7-25.4 mm SL, 2 c&s; UFBA 5526, 13, 16.6-29.6 mm SL.

Comparative material examined. Brazil. Bahia State. *Hemigrammus brevis*, UFBA 165, 93, 10, 15.9-21.7 mm SL. *Hemigrammus gracilis*, UFBA 5457, 10, 19.7-23.5 mm SL. *Hyphessobrycon bifasciatus*, UFBA 4971, 19, 16.3-33.4 mm SL. *Hyphessobrycon micropterus*, UFBA 2843, 1, 23.5 mm SL. *Hyphessobrycon negodagua*, UFBA 4301, 9, 17.4-21.1 mm SL. *Hyphessobrycon parvellus*, UFBA 4309, 60, 10, 10.3-20.2 mm SL. *Hyphessobrycon vinaceus*, UFBA 4608, 10, 34.3-61.7 mm SL. *Hyphessobrycon ellisi*: **Peru.** CAS 47167, 2 of 37 syntypes, 28.2-29.1 mm SL. **Bolivia.** USNM 117544, syntype, 31.9 mm SL.

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