

Original article

## A new species of *Astyanax* (Characiformes: Characidae) from the rio de Contas basin, Bahia, Brazil

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A new species of *Astyanax* from tributaries of the rio de Contas, Bahia, Brazil, is described. The new species differs from congeners by having three horizontal series of scales from lateral line to pelvic-fin origin and the distal margin of third infraorbital distinctly separated from vertical and horizontal limbs of preopercle, leaving a broad area not covered by superficial bones. The new species further differs from most congeners by the presence of bony hooks on all fins of mature males. Particularly from congeners occurring in rivers of the Northeastern Mata Atlântica freshwater ecoregion, it further differs by having the highest body depth just anterior to the dorsal-fin origin, 34–37 pored lateral line scales, a vertically elongated conspicuous dark humeral blotch reaching below the lateral line and a conspicuous dark wide midlateral stripe extending from the clear area on the rear of the humeral blotch to the end of middle caudal-fin rays and forming an inconspicuous blotch on caudal peduncle.

**Keywords:** Endemism, Northeastern Mata Atlântica freshwater ecoregion, Sexual dimorphism, Taxonomy.

Uma espécie nova de *Astyanax* de tributários do rio de Contas, Bahia, Brasil, é descrita. A espécie nova difere das congêneres por ter três séries horizontais de escamas entre a linha lateral e a origem da nadadeira pélvica e margem distal do terceiro infraorbital distintamente separada dos ramos vertical e horizontal do pré-opérculo, deixando uma ampla área sem ossos superficiais. A espécie nova difere, ainda, da maioria das congêneres pela presença de ganchos ósseos em todas as nadadeiras de machos maduros. Particularmente das congêneres que ocorrem nas drenagens da Ecorregião Mata Atlântica Nordeste, difere ainda por ter a maior altura do corpo imediatamente anterior à origem da nadadeira dorsal, 34–37 escamas perfuradas na linha lateral, presença de uma mancha umeral conspícua, verticalmente alongada, ultrapassando ventralmente a linha lateral e uma faixa escura mediana lateral larga, estendendo-se da área clara após a mancha umeral até o fim dos raios medianos caudais e formando uma mancha inconspícua no pedúnculo caudal.

**Palavras-chave:** Dimorfismo sexual, Ecorregião Mata Atlântica Nordeste, Endemismo, Taxonomia.

### Introduction

*Astyanax* Baird & Girard is one of the most species-rich genera within Characidae, with 176 valid species (Fricke *et al.*, 2019). Furthermore, possibly it is among the genera with higher number of species being described lately, with approximately 80 new species in the last 20 years. Particularly to drainages inserted in the Northeastern Mata Atlântica freshwater ecoregion (*sensu* Abell *et al.*, 2008; NMAF), 11 species were described in that period (*e.g.*, *A. brucutu* Zanata, Lima, Di Dario & Gerhard, *A. epiagos* Zanata & Camelier, *A. hamatilis* Camelier & Zanata, *A. lorien* Zanata, Burger & Camelier, *A. pelecus* Bertaco & Lucena, *A. sincora* Burger, Carvalho & Zanata). All of them are apparently endemic to their respective river basin and none of them or other known species of *Astyanax* was described from the rio de Contas basin. Taxonomic aspects of the ichthyofauna

of the rio de Contas are known basically by description of new species of different taxa [*e.g.*, *Cyphocharax pinnilepis* Vari, Zanata & Camelier, *Hasemania piatan* Zanata & Serra, *Hyphessobrycon brumado* Zanata & Camelier, *Ituglanis agreste* Lima, Neves & Campos-Paiva, *Megaleporinus brinco* (Birindelli, Britski & Garavello), *Nematocharax varii* Barreto, Silva, Batalha-Filho, Affonso & Zanata]. Some of these studies represent the few citations regarding species of *Astyanax* to the rio de Contas basin, usually solely as syntopic fauna to their new species. Other relevant studies including species of *Astyanax* from the rio de Contas have cytogenetic or molecular approaches (*e.g.*, Affonso *et al.*, 2007; Medrado *et al.*, 2008, 2015; Pamponet *et al.*, 2008), or are represented by not published thesis (*e.g.*, Silva, 2015). Recent ichthyological surveys in the rio de Contas basin yielded a new species of *Astyanax* apparently endemic to this basin that is described herein.

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### 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 head length (HL). Meristic data are provided in the description, an asterisk indicates counts of the holotype and the frequency of each count is given in parentheses. The number of horizontal scale rows between dorsal-fin origin and the lateral line does not include a scale of predorsal series situated just anterior to first dorsal-fin ray or the short series of small scales just below dorsal-fin base. Counts of vertebrae, supraneurals, procurrent caudal-fin rays, branchiostegal rays, and gill rakers were taken only from cleared and stained specimens (c&s), prepared according to Taylor, Van Dyke (1985). Precaudal vertebrae include the Weberian apparatus and the vertebrae associated with ribs or haemal arches without haemal spines. Caudal vertebrae are vertebrae associated with haemal spines. The fused first preural and first ural centrum of the caudal region are counted as a single element. The pattern of *circuli* and *radii* was examined on scales sampled from the region between the lateral line and the dorsal-fin origin. The sex of specimens

was confirmed by dissection. Institutional abbreviations follow Fricke, Eschmeyer (2019). Comparisons with species not cited in the ‘Comparative material examined’ were based on the literature information (e.g., Eigenmann, 1911, 1921, 1927; Azpelicueta, Garcia, 2000; Melo, 2000; Bertaco, Malabarba, 2001; Azpelicueta *et al.*, 2002a, b; Almirón *et al.*, 2002; Triques *et al.*, 2003; Haluch, Abilhoa, 2005; Bertaco, Lucena, 2006; Abilhoa, Duboc, 2007; Alcaraz *et al.*, 2009; Azpelicueta, Loureiro, 2009; Bertaco, Lucena, 2010; Bertaco *et al.*, 2010; Garavello, Sampaio, 2010; Tagliacollo *et al.*, 2011; Lucena *et al.*, 2013, 2017; Oliveira *et al.*, 2013, 2017; Ingenito, Duboc, 2014; Zanata *et al.*, 2017).

### *Astyanax varii*, new species

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### Figs. 1–3; Tab. 1

*Astyanax* sp. 6.—Camelier, Zanata (2014):686, tab. 1 [listed; species from the Northeastern Mata Atlântica freshwater ecoregion].

*Astyanax* sp.—Barreto *et al.* (2018): 1158 [citation; co-occurrence with *Nematocharax varii*].



**Fig. 1.** *Astyanax varii*, Brazil, Bahia State: (a) MZUSP 121062, holotype, 41.4 mm SL, Ubaitaba, lower rio de Contas basin, rio Coricó; (b) live paratype, not catalogued.



**Holotype.** MZUSP 121062, 41.4 mm SL, Brazil, Bahia, Ubaitaba, rio Coricó in Fazenda Progresso, near the road BR-330, lower rio de Contas basin, 14°14'50"S 39°22'39"W, 65 m above sea level (a.s.l.), 13 Feb 2008, A. M. Zanata, R. Burger, P. Camelier & A. B. A. Góes.

**Paratypes.** All specimens from Brazil, Bahia, rio de Contas basin. MCP 54205, 10, 31.9–40.3 mm SL; UFBA 8405, 16, 22.2–41.4 mm SL, 2 c&s 35.1–36.7 mm SL, rio Água Suja on road BA-148, border between Abaira and Jussiape, upper rio de Contas basin, 13°22'7.8"S 41°40'01"W, 545 m a.s.l., 18 Jun 2017, A. M. Zanata, R. Burger & G. V. Oliveira. MZUSP 112058, 6, 21.4–34.0 mm SL, rio Gongogi on the border between Itajibá and Ibicuí municipalities, lower rio de Contas basin, 14°21'16.5"S 39°46'23.9"W, 164 m a.s.l., 13 Aug 2012, J. L. O. Birindelli, F. C. P. Dagosta & M. V. Loeb. MZUSP 125529, 10, 30.3–44.3 mm SL; UFBA 4515, 14, 26.2–41.3 mm SL, collected with the holotype. MZUSP 125530, 24, 34.1–40.3 mm SL; NUP 21946, 10, 26.0–36.8 mm SL; UFBA 8380, 49, 22.8–41.0 mm SL, 2 c&s 34.5–41.0 mm SL, Jussiape, Caraguatá, rio Água Suja at Balneário Rio da Barra, upper rio de Contas basin, 13°24'14.5"S 41°38'7.8"W, 529 m a.s.l., 18 Jun 2017, A. M. Zanata, R. Burger & G. V. Oliveira. UFBA 8450, 4, 24.8–39.5 mm SL, rio Água Suja, on road BA-148, between Abaira and Jussiape, upper rio de Contas basin, 13°24'35.4"S 41°37'60"W, 531 m a.s.l., 5 Mar 2017, A. M. Zanata & R. Burger. UFBA 7046, 3, 28.8–33.2 mm SL, Dário Meira, rio Gongogi under bridge in Dário Meira, lower rio de Contas basin, 14°26'12"S 39°54'13.4"W, 180 m a.s.l., 12 Dec 2011, A. M. Zanata, P. Camelier, J. O. Birindelli, R. Burger & B. Sardeiro.

**Diagnosis.** *Astyanax varii* can be distinguished from most congeners, except *A. brachypterygium* Bertaco & Malabarba, *A. brucutu*, *A. cremnobates* Bertaco & Malabarba, *A. epiagos*, *A. eremus* Ingenito & Duboc, *A. gymnogenys* Eigenmann, *A. rupestris* Zanata, Burger & Camelier, *A. taeniatus* (Jenyns), *A. totae* Haluch & Abilhoa, and *A. varzeae* Abilhoa & Duboc, by having the distal margin of third infraorbital distinctly separated from vertical and horizontal limbs of preopercle (Fig. 2), leaving a broad area without superficial bones (vs. margins of the third infraorbital close to the limbs of preopercle, with narrow or no space between the two bones). The new species differs from the aforementioned species by having three horizontal series of scales from the lateral line to the pelvic-fin origin (vs. four or more series of scales) and by having small bony hooks on all fins of mature males (vs. bony hooks absent or not present on all fins of mature males). *Astyanax varii* also differs from the species listed above by having highest body depth approximately at vertical through dorsal-fin origin (vs. body deepest on a vertical through middle or posterior portion of pectoral fin in *A. brachypterygium*, *A. cremnobates*, *A. epiagos*, *A. eremus*, *A. gymnogenys*, *A. rupestris*, *A. totae*, and *A. varzeae*), five horizontal series of scales from the dorsal-fin origin to the lateral line (vs. six or more in *A. brachypterygium*, *A. brucutu*, *A. cremnobates*, *A.*

*eremus*, *A. rupestris*, *A. totae*, *A. taeniatus*, and *A. varzeae*), 14 horizontal scale rows around caudal peduncle (vs. 15 or more in *A. brachypterygium*, *A. eremus*, *A. gymnogenys*, and *A. totae*), and 34–37 pored lateral line scales (vs. 38 or more in *A. eremus*, *A. gymnogenys*, and *A. taeniatus*).

**Description.** Morphometric data of the holotype and paratypes are given in Tab. 1. Body compressed and elongate; highest body depth approximately at vertical through dorsal-fin origin. Dorsal profile of head convex from upper lip to vertical through anterior nostrils; straight to slightly convex from latter point to tip of supraoccipital spine. Dorsal profile of body nearly straight to slightly convex from tip of supraoccipital spine to dorsal-fin origin; straight and posteroventrally slanted from dorsal-fin origin to adipose fin and slightly concave or nearly straight along caudal peduncle. Ventral profile of head usually straight to slightly convex from anterior tip of dentary to isthmus. Ventral body profile slightly convex from isthmus to anal-fin origin; straight and posterodorsally slanted along anal-fin base and nearly straight to slightly concave along caudal peduncle.

Head somewhat pointed to rounded anteriorly in lateral profile. Mouth terminal; upper jaw similar in length anteriorly or slightly longer than lower jaw. Posterior terminus of maxilla extending beyond vertical through anterior margin of orbit. Infraorbital series moderately developed; ventral margin of third infraorbital falling distinctly short from horizontal limb of preopercle and leaving a relatively broad area without superficial bones (Fig. 2). Number of infraorbitals variable, with 4(1) or 6(2) ossifications. One specimen with four elements on one side of head (UFBA 8380, 41.0 mm SL) apparently presenting infraorbitals 1 and 2 as independent elements, 3+4+5 fused resulting in one element, and infraorbital 6 independent. Supraorbital absent.



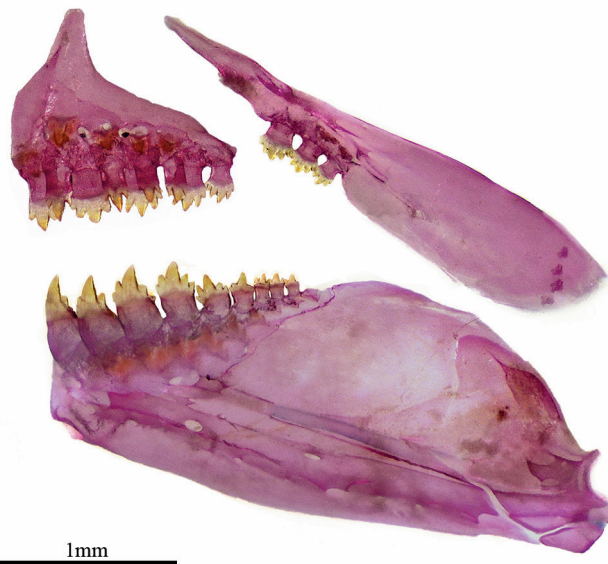
**Fig. 2.** Head of *Astyanax varii*, UFBA 8380, paratype, 40.8 mm SL, 9.3 mm HL, alizarin stained, lateral view, left side.

**Tab. 1.** Morphometric data for *Astyanax varii*, new species; n= 30, range includes holotype. SD= standard deviation.

	Holotype	Range	Mean	SD
Standard length (mm)	41.4	29.1–44.3	37.6	-
Percentages of standard length				
Depth at dorsal-fin origin	31.4	28.8–33.6	31.0	1.4
Snout to dorsal fin origin	51.0	48.6–53.0	51.0	1.0
Snout to pectoral-fin origin	24.4	23.6–26.5	24.9	0.8
Snout to pelvic-fin origin	45.7	45.3–48.9	47.1	1.1
Snout to anal-fin origin	61.8	61.2–65.3	63.5	1.2
Caudal peduncle depth	10.6	10.6–12.1	11.4	0.4
Caudal peduncle length	15.9	13.7–16.9	15.0	0.7
Pectoral-fin length	20.5	19.9–22.6	21.2	0.7
Pelvic-fin length	13.0	12.9–15.1	13.9	0.6
Dorsal-fin base length	11.6	11.3–14.4	13.0	0.8
Dorsal-fin height	24.4	23.1–26.6	25.2	1.0
Anal-fin base length	23.4	23.4–27.3	25.2	1.0
Anal-fin lobe length	17.6	15.8–20.3	18.1	0.8
Eye to dorsal-fin origin	36.2	35.1–37.6	36.3	0.6
Dorsal-fin origin to caudal-fin base	52.7	50.0–54.3	52.5	1.1
Head length	24.9	23.4–26.6	24.9	0.9
Percentages of head length				
Horizontal eye diameter	38.8	34.7–40.0	37.8	1.4
Snout length	23.3	19.8–23.9	22.3	1.0
Least interorbital width	29.1	28.2–32.1	30.6	1.0
Upper jaw length	40.8	40.2–43.9	42.3	1.2

Premaxillary teeth in two rows (Fig. 3). Outer row with 2(1), 3\*(24), or 4(5) teeth bearing 3 or 5 cusps. Inner row with 5\*(30) teeth usually bearing 7 cusps, rarely 5; second tooth the largest, with 7 cusps; last tooth with 5 or 7 cusps; symphyseal tooth of inner series asymmetrical, with 1 or 2 cusps on anteromedial side, one larger central cusp and three smaller on lateral side. Maxilla with 2(7), 3\*(17), or 4(6) teeth bearing 5 to 7 cusps. Dentary with 8(8), 9(7), 10\*(15), or 11(5) teeth decreasing gradually in size and number of cusps posteriorly; symphyseal tooth symmetrical with 7 cusps, followed by teeth with 5 or 6 cusps and posteriormost teeth with 3 cusps.

Scales cycloid; *circuli* conspicuous anteriorly but absent on exposed area of scales; few parallel *radii* extending to posterior margin of scale. Lateral line slightly decurved ventrally, with 34(3), 35(7), 36\*(17), or 37(2) perforated scales, continuous from supracleithrum to caudal-fin base. Longitudinal scale rows between dorsal-fin origin and lateral line 5\*(30). Longitudinal scale rows between lateral line and pelvic-fin insertion 3\*(30). Scales along middorsal line between tip of supraoccipital process and origin of dorsal fin 9(3), 10(8), 11\*(15), or irregular (4). Horizontal scale rows around caudal peduncle 14\*(29). Base of anteriormost anal-fin rays with single scale row composed of 4 or 5 scales. Axillary scale absent. Caudal fin not scaled.

**Fig. 3.** Upper and lower jaws of *Astyanax varii*, UFBA 8405, paratype, 35.1 mm SL, lateral view, left side.

Dorsal-fin rays ii, 9\*(30). Distal margin of dorsal fin straight or slightly rounded. Dorsal-fin origin located approximately at middle of standard length and posterior to vertical through pelvic-fin origin. Base of last dorsal-fin ray aligned with anal-fin origin. First dorsal-fin pterygiophore inserting behind neural spine of 9<sup>th</sup>(3) or 10<sup>th</sup>(1) vertebra. Adipose fin present. Anal-fin rays iii(23), 17(3), 18\*(7), 19(15), or 20(5). Distal margin of anal fin concave. First anal-fin pterygiophore inserting behind haemal spine of 16<sup>th</sup>(2) or 17<sup>th</sup>(2) vertebra. Pectoral-fin rays i(30), 10(1), 11\*(15), or 12(13). Tip of pectoral fin not reaching vertical through pelvic-fin insertion. Pelvic-fin rays i, 7\*(30); tip of pelvic fin not reaching first anal-fin insertion. Caudal fin forked, lobes pointed, similar in size. Principal caudal-fin rays 9+9(1), 9+10(2), or 9+11(1). Nine(1) or 11(3) dorsal procurrent caudal-fin rays and 7(1) or 10(3) ventral procurrent caudal-fin rays.

Total vertebrae 35(3) or 36(1). Precaudal vertebrae 15(3) or 16(1); caudal vertebrae 19(1) or 20(3). Supraneurals 4(2) or 5(2). Branchiostegal rays 4(2). First gill arch with 5(4) gill rakers on epibranchial, 8(4) on hypobranchial and ceratobranchial, and 1(4) on cartilage between ceratobranchial and epibranchial.

**Color in alcohol.** Overall ground color pale yellow or light brown (Fig. 1a). Guanine restricted to infraorbitals, preopercle, and opercle. Dorsal part of head moderately dark anteriorly and usually darker on posterior half; presence of two large black rounded blotch on posterior part of head in some specimens. Small melanophores sparsely distributed throughout maxilla. Infraorbitals poorly pigmented, with few melanophores close to orbit; infraorbitals four to six more pigmented, with large melanophores sparsely distributed. Opercle with sparse melanophores, usually more concentrated on its dorsal half; ventral third usually



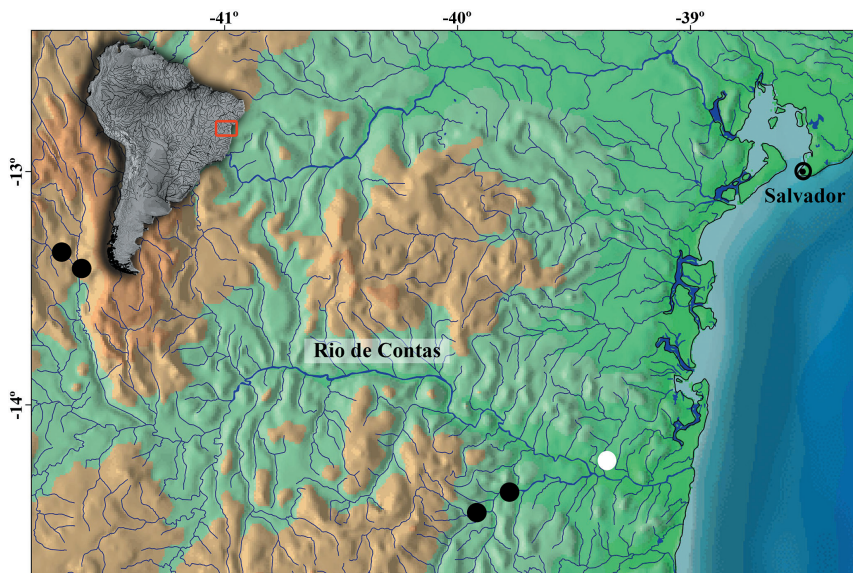
without dark pigmentation. Concentration of melanophores on opercle usually resembling a vertically elongated blotch, somewhat similar to the humeral blotch. Ventral portion of head pale or with a few diminute scattered melanophores on anteriormost portion. Middorsal line of body distinctly darkened. Humeral region with a conspicuous vertically elongated humeral blotch, formed by underlying and superficial melanophores; blotch over two or three scales on horizontal series immediately above lateral line, tapering ventrally and occupying one scale below lateral line. Humeral blotch bordered anteriorly and posteriorly by clearer areas. Dark broad midlateral stripe extending from the rear of clear area posterior to humeral blotch to caudal peduncle. A dark rounded blotch, with inconspicuous borders, present on caudal peduncle in most specimens; blotch when present, partially merged with the stripe. Two or three dorsalmost longitudinal scale series of flank usually with dark small chromatophores concentrated along their posterior margins, resulting in reticulate pattern; center of scales clearer, with few sparse larger melanophores; some specimens darker overall and reticulate pattern substituted by a more homogeneous dark pigmentation on scales. In some specimens with more defined reticulate pattern, the dark margins of scales are narrower along lateral line and one to three horizontal series of scales below it. Remaining scales along flank with sparse melanophores; dark lines usually present along myosepts above anal-fin base. Abdominal region clear. All fins darkened in some degree, with sparse melanophores concentrated on margins of rays; dorsal, anal, and caudal fins somewhat darker than pectoral and pelvic fins. Adipose fin with scattered small melanophores.

**Color in life.** Color pattern similar to the described in alcohol (Fig. 1b). Overall ground color yellow. Iris, infraorbitals, and opercle silvery. Humeral blotch faint or

not discernible. Dark midlateral stripe more conspicuous on posterior half of body, extending to middle caudal-fin rays. Unpaired fins yellowish at least on its proximal half. Pectoral and pelvic fins hyaline or poorly pigmented. Adipose fin yellowish.

**Sexual dimorphism.** Mature males of *Astyanax varii* have variable presence of hooks on fins and the examined mature females have no bony hooks on any of the fins. Some mature males possess tiny bony hooks on all fins (e.g., UFBA 4515, 29.1–34.3 mm SL), but most mature males have hooks restricted to the pectoral, pelvic, and anal fins. Anal fin of mature males with one to six hooks distributed up to the tenth first branched ray; hooks more numerous and larger on the anterior branched rays and always distally located on the posterior branch of rays. When present in the dorsal fin, up to six small hooks distributed on the first eight branched rays; hooks always distally located on the posterior branch of ray. Pectoral fins of mature males with up to six tiny hooks on the distal portion of up to the seventh branched ray. Pelvic fins with two or three small hooks on the distal portion of third to the sixth branched rays. When present in the caudal fin, very small hooks restricted to the four centralmost caudal-fin rays. No other dimorphic morphological character was observed externally in the specimens examined, except by the body size. Females apparently reach larger body sizes than males (largest female observed 53.3 mm SL vs. largest male 37.9 mm SL). Males are completely mature around 29.0 mm SL and females at the same size are completely immature. The smallest mature female examined had 35.0 mm SL.

**Geographical distribution.** *Astyanax varii* is known from tributaries of rio de Contas basin, Bahia State, Brazil (Fig. 4).



**Fig. 4.** Collection localities of *Astyanax varii*, rio de Contas basin, Bahia, Brazil. White dot = type locality; black dots = additional localities. Some circles indicate more than one sampling site.

**Ecological notes.** *Astyanax varii* was collected in three localities of the upper and three of the lower rio de Contas basin, in altitudes ranging from 65 to 545 m a.s.l. (Figs. 5a–b). The stretches sampled in tributaries of the lower portion of the basin are 5–25 m wide, up to 1.8 m deep, with rocky, muddy, or sandy substrate and bordered by aquatic vegetation and trees. In that localities, *A. varii* was collected syntopically with 13 species: *Apareiodon itapicuruensis* Eigenmann & Henn, *Astyanax* sp., *Cetopsorhamdia iheringi* Schubart & Gomes, *Cyphocharax pinnilepis*, *Geophagus brasiliensis* (Quoy & Gaimard), *Hemigrammus marginatus* Ellis, *Hypostomus* sp., *Leporinus bahiensis* Steindachner, *Nematocharax venustus* Weitzman, Menezes & Britski, *Poecilia reticulata* Peters, *Serrapinnus piaba* (Lütken), *Serrapinnus* sp., and *Serrasalmus brandtii* Lütken. In the upper rio de Contas, the species was sampled in three nearby locations in the rio Água Suja. One of them is the Balneário Rio da Barra (Fig. 5b), an artificial reservoir approximately 100 m long, 30 m wide, and 1.1 m deep on average, which

is used mostly as a bathing place. The other sampling points in the rio Água Suja are up to 12 m wide and up to 1 m deep, with rocky and sandy-bottomed habitats, moderate water current, and with riparian vegetation mainly composed by grass and sparse trees. In those localities, *A. varii* was collected syntopically with 16 species: *Acestrorhynchus lacustris* (Lütken), *Apareiodon itapicuruensis*, *Astyanax* aff. *lacustris* (Lütken), *Astyanax* aff. *fasciatus* (Cuvier), *Characidium* sp., *Cyphocharax gilbert* (Quoy & Gaimard), *Coptodon* sp., *Geophagus brasiliensis*, *Hemigrammus marginatus*, *Hypostomus* sp., *Leporinus* sp., *Megaleporinus brinco*, *Nematocharax varii*, *Parotocinclus* sp., *Poecilia reticulata*, and *Serrasalmus brandtii*.

The analysis of stomach contents of two specimens of *A. varii* revealed the presence of allochthonous and autochthonous items, composed predominantly by filamentous algae and fragments of vascular plants and seeds, organic debris, insect aquatic larvae (Diptera: Chironomidae and Simuliidae) and fragments of unidentified insects.



**Fig. 5.** Collecting sites of *Astyanax varii*: (a) type locality, Brazil, Bahia State, Ubaitaba, Fazenda Progresso, rio Coricó, lower rio de Contas basin; (b) Brazil, Bahia State, Jussiape, Caraguataí, rio Água Suja at Balneário Rio da Barra, upper rio de Contas basin.



**Etymology.** The specific name *varii* is in honor to the ichthyologist Richard P. Vari for his friendship, mentoring, and outstanding contribution to the systematic of South American freshwater fishes.

**Conservation status.** *Astyanax varii* had been collected in six localities in the upper and lower rio de Contas basin. The main locality sampled in the upper rio de Contas, the Balneário Rio da Barra, is an artificial reservoir continually exploited for tourism as a bathing place (Barreto *et al.*, 2018). Permanent anthropic perturbation such as loss of riparian vegetation and dams occurs in the main channel and some tributaries of rio de Contas (Cetra *et al.*, 2010; Sarmiento-Soares *et al.*, 2016). Despite some records of threats for the region, such as deforestation, water pollution, and erosion, there are no data about the direct effects of these threats to the populations of *A. varii* so far. Therefore, with the currently available data, and according to the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN Standards and Petitions Subcommittee, 2017), *A. varii* should be classified as Least Concern (LC).

## Discussion

A total of 79 species of *Astyanax* was described in the last 20 years (Fricke *et al.*, 2019), being one of the fish genera with higher expansion on its richness knowledge. Advances in alpha taxonomy of the ichthyofauna of the Brazilian coastal drainages contributed with 21 of those descriptions, being 11 from the Northeastern Mata Atlântica freshwater ecoregion (e.g., Rangel-Pereira, 2012; Birindelli *et al.*, 2013; Lima *et al.*, 2013; Mattos, Costa, 2018; Barreto *et al.*, 2018; Burger *et al.*, 2019); seven from rivers draining the Laguna dos Patos freshwater ecoregion (e.g., Lucena *et al.*, 2013; Bertaco, Vigo, 2015), one species from the Tramandai-Mampituba freshwater ecoregion (Bertaco, 2014), one species from the Ribeira de Iguape freshwater ecoregion (Silva *et al.*, 2019), and one from the Southeastern Mata Atlântica freshwater ecoregion (Oliveira *et al.*, 2013). Particularly to the NMAF, nine of the 11 species mentioned are from river basins inserted in the Bahia State, highlighting the rio Paraguaçu basin, with six described species, all of them apparently endemic to this basin (*A. brucutu*, *A. epiagos*, *A. hamatilis*, *A. lorien*, *A. rupestris*, and *A. sincora*). Conversely, *Astyanax* is poorly documented to the rio de Contas basin in the taxonomic literature, being usually not identified confidently at specific level [e.g., *Astyanax* gr. *bimaculatus* (Linnaeus) in Cetra *et al.*, 2010; *A. aff. lacustris* (Lütken) in Zanata, Camelier, 2010; *A. gr. fasciatus* and *A. gr. lacustris* in Barreto *et al.*, 2018] or identified as *Astyanax* sp. (e.g., Camelier, Zanata, 2014; Sarmiento-Soares *et al.*, 2016). Similarly, species of *Astyanax* are alternately confidently identified at specific level or not in cytogenetics or molecular studies (e.g., *A. fasciatus* in Medrado *et al.*, 2008; *A. aff. fasciatus* in Medrado *et al.*, 2015; *A. aff. bimaculatus* in Pamponet

*et al.*, 2008; *A. bimaculatus* in Lima *et al.*, 2013). Such taxonomic difficulties corroborate the poor geographical and taxonomic species delimitation of the species complexes in which the species cited above are included. Also, the cited shortcomings confirm the need of comparative taxonomic studies, including populations of *Astyanax* from the rio de Contas basin, to check for the presence of *A. fasciatus*, *A. bimaculatus*, or *A. lacustris* in this basin.

*Astyanax varii* is the first species of the genus described from the rio de Contas and the species does not fit in any of the species groups, traditionally used to the genus. In addition to the diagnosis given previously, the new species can be differentiated from congeners surely identified at specific level, inhabiting rivers comprised in the NMAF, by a series of characters. The species differs from *A. bahiensis* (Steindachner), *A. brevirhinus* Eigenmann, *A. brucutu*, *A. burgerai* Zanata & Camelier, *A. epiagos*, *A. hamatilis*, *A. lorien*, *A. jacobinae* Zanata & Camelier, *A. pelecus*, *A. rupestris*, *A. sincora*, *A. turmalinensis* Triques, Vono & Caiafa, and *A. vermilion* Zanata & Camelier by having a conspicuous dark wide midlateral stripe extending from the rear of the clear area posterior to the humeral blotch to the end of middle caudal fin rays, not forming a conspicuous blotch on the caudal peduncle (*vs.* absence of conspicuous lateral stripe and/or presence of a conspicuous caudal blotch), from *A. burgerai*, *A. epiagos*, *A. jacobinae*, *A. lorien*, *A. microschemos* Bertaco & Lucena, *A. rupestris*, *A. sincora*, and *A. turmalinensis* by having the highest body depth approximately at vertical through the dorsal-fin origin (*vs.* body deepest on a vertical approximately at midlength or posterior portion of pectoral fin), from *A. brevirhinus* by the presence of a vertically elongated conspicuous dark humeral blotch (*vs.* presence of horizontally elongate black humeral blotch), and from *A. pelecus* by having 34–37 pored lateral line scales and humeral blotch with its ventral portion located ventrally to the lateral line series (*vs.* 38–39 pored lateral line scales and humeral blotch limited to the region above lateral line).

The endemic nature of the fish fauna of the rio de Contas is exemplified by eight endemic species, including *Cyphocharax pinnilepis*, *Hasemanian piatan*, *Hyphessobrycon brumado*, *Ituglanis agreste*, *Megaleporinus brinco*, *Nematocharax varii*, *Parotocinclus jimi* Garavello, and the new species described herein. The rio de Contas basin ranks second in number of endemic fish species after the rio Paraguaçu basin, among river basins completely included in the Bahia State. Thus, the fish fauna of the rio de Contas, known up to date, is in agreement with the statement of previous authors about coastal drainages of eastern Brazil being recognized as a very distinct area in terms of their ichthyofauna, mainly expressed by the high endemism at species and genus level (e.g., Bizerril, 1994; Camelier, Zanata, 2014). Apart from endemities restrict to the basin itself, according to Camelier, Zanata (2014), one of the few publications with somewhat broader taxonomic information on its fish fauna,

high ichthyofaunistic similarities among the rio de Contas basin and a group of 16 coastal river basins from the NMAF is evident, more specifically with rios Cachoeira, Almada, Una, Pardo, and Jequitinhonha basins. Two species are shared exclusively by these five basins, forming the Central group of Camelier, Zanata (2014), *Nematocharax venustus* and *Oligosarcus macrolepis* (Steindachner). *Astyanax varii* is apparently endemic to the rio de Contas basin and, consequently, not present in other basins of the Central group.

**Comparative material examined.** Additional to Zanata, Camelier (2009) and Zanata *et al.* (2018): *Astyanax lorien*: MZUSP 123398, holotype, 66.4 mm SL; UFBA 8109, paratypes, 10, 38.1–56.1 mm SL, Brazil, Bahia, rio Paraguaçu basin. *Astyanax rupestris*: MZUSP 89567, holotype, 85.2 mm SL; UFBA 2789, paratypes, 19, 24.3–66.0 mm SL; Brazil, Bahia, rio Paraguaçu basin. *Astyanax sincora*: MZUSP 120747, holotype, 46.0 mm SL; UFBA 8200, paratypes, 49, 11.7–61.5 mm SL, Brazil, Bahia, rio Paraguaçu basin.

### Acknowledgments

We thank André T. Silva (UESB) for the photo of the alive specimen. We also thank Victor Gomes (UFBA) for the identification of insects of the stomach contents. Funding for field work in which the new species also was collected was provided by CNPq (grant # 476495/2010-5; # 562335/2010-2). Authors were funded by CNPq (PC grant # 423760/2018-1 and RB Protax # 440534/2015-1), FAPESB (GV grant # 310/2016), and FAPESP (PC grant # 2016/19075-9; 2017/09321-5). Permission for collecting specimens was granted by IBAMA # 13754-1.

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Submitted June 12, 2019

Accepted August 19, 2019 by Fernando Carvalho