

## Two new species of *Moenkhausia* Eigenmann (Characiformes: Characidae) from Serra do Cachimbo, Pará, Northern Brazil

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Two new species of *Moenkhausia*, one from the rio Tapajós and the other from the rio Xingu basins are described as apparently endemics of the Serra do Cachimbo. Both species, along with *M. petymbuaba*, share a distinct color pattern composed of large conspicuous dark blotches on the base of the body scales. *Moenkhausia chlorophthalma*, from rio Treze de Maio, a tributary to rio Curuá (rio Xingu basin), is distinguished by the presence of a proximal well delimited black area on the adipose fin and a green eye in life. *Moenkhausia plumbea* of the headwaters of tributaries of the rio Braço Norte, rio Tapajós basin is diagnosed by the presence of a dark longitudinal stripe across the eye and six branched pelvic-fin rays (*vs.* seven). Relationships of the new species with other *Moenkhausia* are discussed.

Duas espécies novas de *Moenkhausia*, uma da bacia do rio Tapajós e outra da bacia do rio Xingu, são descritas como aparentemente endêmicas da Serra do Cachimbo. Ambas, juntamente com *M. petymbuaba*, compartilham um padrão de colorido exclusivo de grandes manchas escuras (conspícuas na base das escamas do corpo). *Moenkhausia chlorophthalma*, do rio Treze de Maio, um afluente do rio Curuá (bacia do rio Xingu), é facilmente reconhecida pela presença de uma área preta bem delimitada na região anterior da nadadeira adiposa e possuir olhos verdes em vida. *Moenkhausia plumbea* ocorre nas cabeceiras dos afluentes do rio Braço Norte, bacia do rio Tapajós, e pode ser diagnosticada pela presença de uma faixa longitudinal escura no olho e seis raios ramificados na nadadeira pélvica (*vs.* sete). As relações entre as novas espécies com as demais *Moenkhausia* são discutidas.

**Key words:** *Moenkhausia chlorophthalma*, *Moenkhausia plumbea*, *Moenkhausia petymbuaba*, Taxonomy, Ostariophysi, Neotropical.

### Introduction

In the first attempt to group the species of *Moenkhausia* into subunits, Géry (1977) recognized three assemblages within the genus based on Eigenmann's (1917: 66-69) key to the species of *Moenkhausia*: the *M. lepidura*-group (shallow-bodied species with relatively few horizontal scale rows on the body); the *M. grandisquamis*-group (deep-bodied species with relatively few horizontal scale rows); and the *M. chrysargyrea*-group (deep-bodied species with relatively numerous horizontal scale rows). Géry (1992) later focused his analysis to the *M. lepidura*-group especially to those species having a distinct dark mark on the upper lobe of caudal fin, independent of body depth or number of horizontal scale rows. Lucinda *et al.* (2007) recently described *M. hysterosticta* as a possibly member of that group. Costa (1994) did not follow Géry's (1977) grouping, suggesting instead a new assemblage comprising *M. oligolepis*, *M. pyrophthalma*, and *M. sanctaefilomenae*. This group was defined by the presence of a distinct reticulate color pattern and a "black bar over the terminal portion of caudal peduncle

and basal portion of caudal fin that is preceded by a light area on the caudal peduncle". Lima & Toledo-Piza (2001) described *M. dyktiota* as possibly related to this assemblage, and more recently two species were added to Costa's (1994) group: *M. cosmops* (Lima *et al.*, 2007), and *M. forestii* (Benine *et al.*, 2009).

Lima & Birindelli (2006) described *Moenkhausia petymbuaba*, based on specimens collected in Serra do Cachimbo, which is the main geographical barrier between the middle courses of the rio Xingu and the rio Tapajós, where the headwaters of those drainages lie close to each other and are in some cases only separated by a few meters. Goulding *et al.* (2003) suggested a high level of endemism for the species from the Serra do Cachimbo, suggestion confirmed by subsequent collections (Birindelli *et al.*, 2009a; Sabaj Pérez, 2009). The description of *Jupiaba kurua* (Birindelli *et al.*, 2009b), and *Leporinus guttatus* (Birindelli & Britski, 2009) from the rio Curuá provided evidence that the fish fauna upstream of the falls at Cachoeira da Serra was isolated from the rest of the drainage and is apparently highly endemic.

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Two undescribed species of *Moenkhausia*, one from the rio Tapajós and another from the rio Xingu basins were discovered in small creeks located near the headwaters of the rio Curuá, with these portions isolated by large waterfalls from downstream portions of those systems. We herein describe both new species, discuss their possible relationships with congeners, and contribute to the understanding of the endemism in the Serra do Cachimbo.

#### Material and Methods

Counts and measurements follow Fink & Weitzman (1974), Menezes & Weitzman (1990) and Lima & Birindelli (2006). All measurements were made point-to-point on the left side of the specimens whenever possible with dial calipers and data recorded to tenths of a millimeter. Standard length is presented in mm, all other measurements are presented as proportions of standard length, except subunits of head which are presented as proportions of head length. Meristic data are given in the description and are followed by the frequency for each count in parenthesis with an asterisk indicating counts of the holotype. Vertebrae, supraneurals, procurrent caudal-fin rays, branchiostegal rays, gill-rakers, teeth counts and numbers of teeth cusps were taken from cleared and stained paratypes (c&s) prepared according to Taylor & van Dyke (1985). Vertebrae of the Weberian apparatus were included in the precaudal counts as four elements, and the fused PU1+U1 was counted as a single element. Pattern of *circuli* and *radii* was defined on scales taken from the region between the lateral line and the dorsal-fin origin. Institutional abbreviations follow Ferraris (2007).

Dentary and premaxillary bones for Scanning Electron Micrographs (SEM) images were prepared by the following procedure: they were removed from cleared and double stained specimens, immersed in weak (less than 1%) sodium hypochlorite solution and dried using successively more concentrated solutions of alcohol and, subsequently, acetone.

#### Results

##### *Moenkhausia chlorophthalma*, new species

##### Figs. 1-3

**Holotype.** MZUSP 99412 (67.4 mm SL), Brazil, Pará, Altamira, rio Treze de Maio, tributary of rio Curuá, rio Iriri basin, rio Xingu drainage, 08°45'06"S 55°02'05"W, 23 Jan 2009, A. L. Netto-Ferreira, J. L. Birindelli, L. M. Sousa & P. Hollanda-Carvalho.

**Paratypes.** ANSP 188909 (5, 32.9-50.3 mm SL), AUM 50663 (5, 37.6-43.6 mm SL), INPA 33764 (5, 34.7-49.4 mm SL), MCP 44509 (5, 41.0-48.0 mm SL), MNRJ 35382 (5, 33.8-48.5 mm SL), MPEP 18327 (5, 37.9-52.9 mm SL) and MZUSP 101426 (81, 23.7-67.9 mm SL), same data as holotype. MZUSP 97092 (28, 38.0-64.8 mm SL, 2 c&s, 43.3-49.6 mm SL), Brazil, Pará, Altamira, rio Treze de Maio, tributary of rio Curuá, rio Iriri basin, rio Xingu drainage, 08°45'06"S 55°02'05"W, 22 Nov 2007, J. L. Birindelli, L. M. Sousa, A. L. Netto-Ferreira, M. H. Sabaj Pérez & N. K. Lujan.

**Diagnosis.** *Moenkhausia chlorophthalma* is distinguished from all congeners, except *M. petymbuaba* and *M. plumbea* by the presence of large dark blotches on the anterior to central portions of the scales forming the seven dorsalmost longitudinal series (*vs.* pigmentation absent or, when present, concentrated posteriorly along the border of the scales, and forming a reticulate pattern on the body). *Moenkhausia chlorophthalma* can be differentiated from both *M. petymbuaba* and *M. plumbea* by the possession of a proximal well-delimited black area on the adipose fin (*vs.* adipose fin with uniformly scattered dark chromatophores), 7 longitudinal rows of large dark blotches (*vs.* 8-9), 25-28 lateral line scales (*vs.* 33-36), 4 scales between the lateral line and the dorsal-fin origin (*vs.* 5), and 7-12 scales covering the anal-fin base (*vs.* 4-9). *Moenkhausia chlorophthalma* can be further separated from *M. petymbuaba* by lacking a conspicuous midlateral dark stripe (*vs.* presence of



**Fig. 1.** *Moenkhausia chlorophthalma*, holotype, MZUSP 99412, 67.4 mm SL, Brazil, Pará, Altamira, rio Treze de Maio, tributary to rio Curuá, rio Iriri basin, rio Xingu drainage.



**Fig. 2.** *Moenkhausia chlorophthalma*, aquarium specimen showing live coloration, Brazil, Pará, Altamira, rio Treze de Maio, collected with holotype.

conspicuous midlateral dark stripe); and from *M. plumbea* by having 7 branched pelvic-fin rays (vs. 6-7 in specimens of *M. plumbea* examined).

**Description.** Morphometric data presented in Table 1. Overall size small (largest examined specimen 67.4 mm SL). Body compressed, moderately elongate. Greatest body depth located slightly anterior to dorsal-fin origin. Dorsal profile of head slightly convex from upper lip to vertical through nares; mostly straight from latter point to tip of supraoccipital spine; convex from tip of supraoccipital spine to dorsal-fin origin, straight from near of dorsal fin base to adipose fin; slightly concave between latter and origin of anteriormost dorsal procurrent caudal-fin ray. Ventral profile of head and body distinctly convex from lower lip to anal-fin origin; straight along anal-fin base, and concave between terminus of anal-fin and anteriormost procurrent caudal-fin ray.

Mouth terminal. Posterior limit of maxilla almost reaching vertical through middle of orbit. Premaxillary teeth in two rows (Fig. 3). Outer row with four (1) or six (1), relatively compressed, tricuspid teeth. Inner row with five (2) bulky tri- to pentacuspid teeth. Symphyseal tooth largest, asymmetrical, with single lateral cusp on anteromedial margin. Maxilla with three equal-sized tricuspid teeth. Dentary with four anteriormost teeth large, robust, pentacuspid, followed by a series of distinctly smaller, conic or tricuspid teeth. First gill arch with 1(2) hypobranchial, 8(2) ceratobranchial, 1(2) on cartilage between ceratobranchial and epibranchial, and 5(1) or 6(1) epibranchial gill-rakers. Branchiostegal rays 4(2), three originating on anterior ceratohyal and one on posterior ceratohyal.

Scales cycloid, with *circuli* absent on exposed area of scales, and few slightly divergent *radii* (usually less than 10) extending to posterior margin of scales. Lateral line slightly curved ventrally, completely pored, with 25(7), 26(10), 27\*(20) or 28(8) perforated scales. Horizontal scale rows between dorsal-fin origin and lateral line 4(45). Horizontal scale rows between lateral line and pelvic-fin insertion 4(45). Predorsal scales 7(16), 8\*(10) or 9(4). Single row of 7(1), 8(1), 9\*(5), 10(12), 11(10) or 12(1) scales covering base of anteriormost anal-fin rays. Fourteen circumpeduncular



**Fig. 3.** Upper and lower jaws of *Moenkhausia chlorophthalma*, paratype, MZUSP 97092, 43.3 mm SL; lateral view, anterior to right, SEM preparation.

**Table 1.** Morphometric data of *Moenkhausia chlorophthalma*. N = 31, SD = standard deviation.

	Holotype	Range	Mean	SD
Standard length (mm)	67.4	38.0-67.4	47.0	
Percents of standard length				
Depth at dorsal-fin origin	35.5	30.6-36.4	33.2	1.5
Snout to dorsal-fin origin	53.4	51.9-56.9	53.9	1.2
Snout to pectoral-fin origin	30.0	28.2-32.6	30.0	0.9
Snout to pelvic-fin origin	49.1	46.1-51.7	48.9	1.4
Snout to anal-fin origin	67.2	62.1-68.5	65.3	1.6
Caudal-peduncle depth	12.0	10.2-13.0	11.7	0.6
Caudal peduncle length	13.1	10.0-14.1	12.0	0.9
Pectoral-fin length	21.1	17.7-23.1	21.3	1.1
Pelvic-fin length	14.7	14.0-15.8	14.9	0.6
Dorsal-fin base length	14.2	13.2-15.3	14.0	0.6
Dorsal-fin length	25.1	21.2-27.2	25.1	1.3
Anal-fin base length	25.5	24.5-28.1	26.5	0.9
Anal-fin lobe length	16.3	15.3-19.8	17.6	1.0
Eye to dorsal-fin origin	38.7	35.8-40.4	37.9	1.0
Dorsal-fin origin to caudal-fin base	51.8	46.6-53.7	51.0	1.3
Bony head length	29.8	27.4-31.3	29.7	1.0
Percents of head length				
Horizontal eye diameter	30.8	30.6-39.6	36.0	2.5
Snout length	27.4	23.9-29.2	26.9	1.4
Least interorbital distance	33.8	28.9-37.3	32.8	1.8
Upper jaw length	54.7	50.6-56.0	53.2	1.2

scales. Caudal-fin scaled on proximal one-fifth of upper and lower caudal-fin lobes.

Pectoral-fin rays i, 10(15) or 11\*(15). Tip of pectoral fin reaching vertical through pelvic-fin origin. Pelvic-fin rays i, 7. Supraneurals 5(2). Dorsal-fin rays ii, 9(46). Dorsal-fin origin situated slightly posterior to middle of standard length. Base of posteriormost dorsal-fin ray located at vertical through anal-fin origin. First dorsal-fin pterygiophore inserted posteriorly to neural spine of 10<sup>th</sup> vertebra (2). Adipose fin present. Anal-fin rays iii, 19(1); iii, 20(1); iv, 18(2); iv, 19\*(12); iv, 20(19); iv, 21(3); iv, 22(1); v, 19(1); v, 20(2) or v, 21(1). Anteriormost anal-fin pterygiophore inserted behind haemal

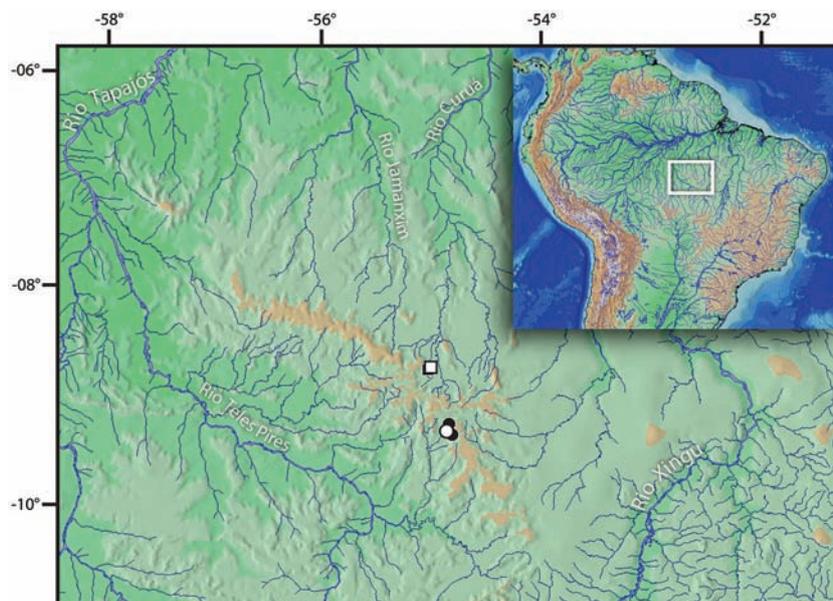
spine of 17<sup>th</sup> (2) vertebra. Caudal-fin forked, lobes slightly rounded, similar in size. Principal caudal-fin rays i, 9+8, i. Dorsal procurent caudal-fin rays 13(2) and ventral procurent caudal-fin rays 9(1) or 11(1). Total vertebrae 34(1) or 35(1), with 16(1) or 17(1) precaudal and 18(2) caudal vertebrae.

**Color in alcohol.** Ground color tan, with chromatophores densely covering entire body, except for ventral portion. Lower lip, snout, top of head and dorsal portion of body darkly pigmented, resulting in overall countershaded color pattern. Edge of upper lip dark. Inconspicuous humeral blotch present, vertically elongated. Seven dorsalmost longitudinal scale rows with scales bearing large dark blotches anterior to center of each, with blotch fading towards scale border. Longitudinal, broad, dark midlateral stripe slightly curved ventrally, extending from pectoral girdle to tip of middle caudal-fin rays. Stripe diffuse, formed by scattered chromatophores. Dorsal, caudal, anal, and pectoral fins hyaline, with small scattered chromatophores. Adipose fin with proximally well-delimited dark area (Fig. 1).

**Color in life.** Ground color of dorsal portion of body yellow to greenish, with iridescent midlateral yellow stripe and large, dark, ventrally curved longitudinal stripe immediately ventral to it, stripe extending from humeral region to caudal peduncle. Abdominal region white to light yellow. Eye bright green. Middle caudal-fin rays with dark mark, anteriorly delimited by dorsal and ventral yellowish areas (Fig. 2).

**Etymology.** From the Greek *chloros*, meaning green, and *ophthalmos*, meaning eye, in reference to the iridescent green eyes in live specimens. An adjective.

**Distribution.** Known from type-locality (Figs. 4 and 5).



**Fig. 4.** Collecting sites and type-localities of *Moenkhausia chlorophthalma* (squares) and *Moenkhausia plumbea* (circles). Open symbols represent type-localities.



**Fig. 5.** Habitats at Serra do Cachimbo: **a** - type-locality of *Moenkhausia chlorophthalma*, rio Treze de Maio, tributary of rio Curuá, rio Xingu basin, 08°45'06"S 55°02'05"W; **b** - type-locality of *Moenkhausia plumbea*, a tributary of rio Braço Norte, tributary of rio Teles Pires, rio Tapajós basin, 09°17'59"S 54°50'00"W; **c** - waterfall in rio Treze de Maio, 08°44'13.2"S 55°01'51.9"W.

*Moenkhausia plumbea*, new species

**Figs. 6-9**

**Holotype.** MZUSP 99415 (49.5 mm SL), Brazil, Pará, Novo Progresso, tributary to rio Braço Norte, at bridge of BR 163 road near Air Force Base, rio Peixoto de Azevedo, rio Teles Pires drainage, rio Tapajós basin; 09°17'59"S 54°50'00"W, 22 Jan 2009; A. L. Netto-Ferreira, J. L. Birindelli, L. M. Sousa & P. Hollanda-Carvalho.

**Paratypes.** All from Brazil, Pará, Novo Progresso. ANSP 188911 (5, 35.1-44.8 mm SL), AUM 50664 (5, 34.3-41.2 mm SL), INPA 33765 (5, 35.5-43.7 mm SL), MCP 44510 (5, 32.8-44.2 mm SL), MNRJ 35384 (5, 37.7-46.3 mm SL), MPEG 18328. (5, 32.3-40.9 mm SL), MZUSP 96849 (14, 34.0-51.2 mm SL, 2 c&s, 39.1, 42.0 mm SL), tributary of rio Braço Norte, rio Peixoto de Azevedo, rio Teles Pires basin, rio Tapajós drainage, 09°19'17"S 54°50'26"W, 10 Nov 2007, J. L. Birindelli, L. M. Sousa, A. L. Netto-Ferreira, M. H. Sabaj Pérez & N. K. Lujan. MZUSP 101435 (24, 20.4-45.9 mm SL), same locality as ANSP 188911, 22 Jan 2009, A. L. Netto-Ferreira, J. L. Birindelli, L. M. Sousa & P. Hollanda-Carvalho. MZUSP 101436 (1, 15.6 mm SL), tributary of rio Braço Norte, at bridge of BR 163 road, near the Air Force Base, rio Peixoto de Azevedo, rio Teles Pires basin, rio Tapajós drainage, 09°21'55"S 54°50'00"W, 22 Jan 2009, A. L. Netto-Ferreira, J. L. Birindelli, L. M. Sousa & P. Hollanda-Carvalho. MZUSP 101439 (10, 30.1-49.3 mm SL), collected with holotype.

**Diagnosis.** *Moenkhausia plumbea* is distinguished from all congeners, except *M. chlorophthalma* and *M. petymbuaba*,

by the presence of large dark blotches on the anterior to the central portions of each scale along the seven dorsalmost longitudinal series (*vs.* pigmentation absent or, when present, concentrated posteriorly along the border of scales and forming a reticulate pattern in the body). *Moenkhausia plumbea* differs from both *M. petymbuaba* and *M. chlorophthalma* in possessing a dark longitudinal stripe along the eye; and is further separated from *M. petymbuaba* in lacking a very conspicuous dark midlateral stripe; and from *M. chlorophthalma* in possessing eight or nine longitudinal rows of large dark blotches (*vs.* seven), 33-36 lateral line scales (*vs.* 25-28), five scales between lateral line and dorsal fin (*vs.* four), 4-9 anal-fin base scales (*vs.* 7-12), and usually 6 branched pelvic-fin rays (*vs.* 7).

**Description.** Morphometric data presented in Table 2. Overall size small (largest examined specimen 49.7 mm SL). Body compressed, moderately elongate. Greatest body depth located slightly anterior to dorsal-fin origin. Dorsal profile of head slightly convex from upper lip to vertical through nares; somewhat straight from latter point to tip of supraoccipital spine; convex from tip of supraoccipital spine to dorsal-fin origin, straight from dorsal fin terminus to adipose fin; slightly concave between latter point and origin of anteriormost dorsal procurrent caudal-fin ray. Ventral profile of head and body distinctly convex from lower lip to pelvic-fin origin; straight from latter point to anal-fin origin, and

along anal-fin base; concave between terminus of anal-fin and anteriormost procurrent caudal-fin ray.

Mouth terminal. Terminus of maxilla located slightly posterior to vertical through anterior margin of orbit. Premaxillary teeth in two rows (Fig. 8). Outer row with 5(2), relatively compressed, tricuspid teeth. Inner row with 5(2) robust pentacuspoid teeth; Symphyseal tooth largest, slightly asymmetrical, with medialmost cusp greatly reduced. Maxilla with two tricuspid equally developed teeth. Dentary with 12(1) or 15(1) teeth; 4 or 5

anteriormost teeth larger, robust, pentacuspoid, posterior ones conic, penta- or tricuspid, distinctly smaller. First gill arch with 2(2) hypobranchial, 8(2) ceratobranchial, 1(2) cartilage between ceratobranchial and epibranchial, and 6(2) epibranchial gill-rakers. Branchiostegal rays 4(2). Three rays originating on anterior ceratohyal and one on posterior ceratohyal.

Scales cycloid, *circuli* absent on exposed portion of scales, with few (usually up to 15) slightly divergent radii extending to posterior margin of scales. Lateral line slightly



**Fig. 6.** *Moenkhausia plumbea*, holotype, MZUSP 99415, 49.5 mm SL, Brazil, Pará, Novo Progresso, tributary to rio Braço Norte, at bridge of BR 163 road near Air Force Base, rio Tapajós basin.



**Fig. 7.** *Moenkhausia plumbea*, aquarium specimen showing live coloration from Brazil, Pará, Novo Progresso, tributary of rio Braço Norte, rio Tapajós basin, collected with MZUSP 96849.



**Fig. 8.** Upper and lower jaws of *Moenkhausia plumbea*, paratype, MZUSP96849, 39.1 mm SL; lateral view, anterior to right. Retroarticular and posterior, smaller teeth of dentary lost during SEM preparation.

curved ventrally, completely pored, with 33(3), 34\*(8), 35(11), 36(7) or 37(1) perforated scales. Horizontal scale rows between dorsal-fin origin and lateral line 5. Horizontal scale rows between lateral line and pelvic-fin insertion 4. Predorsal scales 9(5), 10\*(24) or 11(1). Single row of 5\*(7), 6(17), 7(4), 8(1) or 9(1) scales covering base of anteriormost anal-fin rays. Caudal peduncle with 14 circumpeduncular scales. Caudal fin scaled, scales present on proximal one-fifth of upper and lower caudal-fin lobes.

Pectoral-fin rays i, 8(1), 9(13) 10\*(15) or 11(1). Tip of pectoral fin almost reaching vertical through pelvic-fin origin. Pelvic-fin rays i, 6\*(32), 7(2). Supraneurals 4(1) or 5(1). Dorsal-fin rays ii (1) or iii (1), 7(1), 8(2) 9\*(27), with first unbranched ray reduced in size. Dorsal-fin origin located slightly posterior to middle of standard length. Base of posteriormost dorsal-fin ray situated at vertical through anal-fin origin. First dorsal-fin

pterygiophore inserted posterior to neural spine of 10<sup>th</sup> vertebra (2). Adipose fin present. Anal-fin rays iii, 20(1); iv, 18(6); iv, 19(3); iv, 20(17); iv, 21(10); iv, 22\*(2); v, 19(1) or v, 20(4). Anteriormost anal-fin pterygiophore inserted behind haemal spine of 17<sup>th</sup> vertebra (2). Caudal fin forked, lobes slightly rounded and similar in size. Principal caudal-fin rays 10+9. Ten (2) dorsal procurent and nine (2) ventral procurent caudal-fin rays. Total vertebrae 35(1) or 36(1) with 17(2) precaudal and 18(1) or 19(1) caudal vertebrae.

**Color in alcohol.** Ground color tan, with chromatophores densely covering whole body, except for abdomen and along distinct unpigmented area extending from eye to caudal peduncle and forming light midlateral stripe. Lower lip, snout, top of head and dorsal portion of body densely covered by small dark chromatophores, resulting in overall countershaded color pattern. Margin of upper lip dark. Vertically elongate humeral blotch present but inconspicuous. Eight or nine dorsalmost longitudinal scale rows with scales bearing large dark blotches on anterior to central portions but fading towards scale margin. Broad, dark, slightly concave midlateral stripe extending from pectoral girdle to tip of median caudal-fin rays. Stripe diffuse, formed by scattered chromatophores. Dorsal, caudal, anal, and pectoral-fins hyaline, with small few chromatophores. Adipose fin dusky, with scattered small chromatophores (Fig. 6).

**Color in life.** Ground color yellowish, with distinct clear midlateral yellow stripe and large, dark, ventrally curved longitudinal stripe immediately ventral to it. Stripes run from humeral region to caudal peduncle. Abdomen white to light yellow. Eye clear, with longitudinal dark stripe. Caudal fin with middle dark stripe delimited anteriorly by upper and lower yellowish areas. Specimens kept in captivity for several months have dorsal and anal fins lightly pigmented with gradients of green, yellow and red (Fig. 7).



**Fig. 9.** *Moenkhausia petymbuaba*, photographed alive, MZUSP97530, Brazil, Pará, Altamira, tributary to rio Curuá, rio Xingu basin. Photo by M. Sabaj Pérez.

**Etymology.** From the Latin *plumbum*, meaning lead, in allusion to the color of the midlateral stripe below the unpigmented stripe in live specimens. An adjective.

**Distribution.** Known from headwaters of tributaries of the rio Braço Norte (rio Tapajós basin) in the Serra do Cachimbo (Figs. 4 and 5).

**Table 2.** Morphometric data of *Moenkhausia plumbea*. N = 32, SD = standard deviation.

	Holotype	Range	Mean	SD
Standard length (mm)	49.7	34.0-49.7	40.1	
Percents of standard length				
Depth at dorsal-fin origin	32.2	30.0-37.5	33.4	1.6
Snout to dorsal-fin origin	52.9	51.8-56.5	53.3	1.0
Snout to pectoral-fin origin	27.0	25.3-29.8	27.3	1.1
Snout to pelvic-fin origin	46.5	44.2-49.3	46.3	1.3
Snout to anal-fin origin	62.0	60.7-65.3	63.3	1.2
Caudal-peduncle depth	10.9	10.3-12.5	11.2	0.5
Caudal peduncle length	13.3	10.5-14.5	12.5	1.0
Pectoral-fin length	19.3	17.6-22.4	20.2	1.2
Pelvic-fin length	14.1	13.8-16.8	15.1	0.8
Dorsal-fin base length	12.9	12.0-14.3	13.0	0.6
Dorsal-fin length	24.7	23.3-29.4	26.2	1.7
Anal-fin base length	28.4	26.6-30.7	28.3	1.0
Anal-fin lobe length	15.9	15.9-21.7	18.7	1.2
Eye to dorsal-fin origin	39.4	37.3-42.6	39.3	1.0
Dorsal-fin origin to caudal-fin base	51.1	50.2-54.2	52.2	1.0
Bony head length	26.6	23.8-28.1	26.1	1.0
Percents of head length				
Horizontal eye diameter	33.3	33.3-40.8	37.9	1.9
Snout length	25.8	23.5-27.7	25.5	1.0
Least interorbital distance	34.8	32.5-36.7	34.6	1.0
Upper jaw length	48.5	42.6-48.5	45.7	1.4

## Discussion

Even though the monophyly of *Moenkhausia* is yet to be demonstrated, the species described herein display the features proposed by Eigenmann (1917) to define that genus. Among their congeners, *M. chlorophthalma*, *M. plumbea*, and *M. petymbuaba* are the only species with a color pattern composed of large dark blotches on the scales of seven to nine dorsalmost longitudinal scale series. Pigmented scales are also observed in species currently assigned to the *M. oligolepis*/*M. sanctaefilomenae* group and *M. diamantina*. However, in those species, the pigmentation is concentrated on the distal border of the scales, thereby forming a dark reticulate pattern on the body. Benine (2002) states that *M. nigromarginata* also has a reticulate pattern, but Costa (1994) did not consider the species as demonstrating this feature. Examination of type specimens of *M. nigromarginata* similarly failed to confirm Benine's (2002) observation. *Moenkhausia cotinho*, which was nested within the *M. oligolepis*/*M. sanctaefilomenae* group by Benine (2002), also has blotches at the bases of the scales, but differs from *M. chlorophthalma*, *M. plumbea*, and *M. petymbuaba* by having small dark patches on the third and fourth longitudinal series above the lateral line, and having a reticulate pattern on the scales below the lateral line series.

Benine (2002) proposed the presence of laminar expansions of the ectopterygoid and the palatine as derived

osteological characters for grouping *M. levidorsa*, *M. sanctaefilomenae*, *M. oligolepis*, *M. cotinho*, and *M. grandisquamis*. Those expansions are variably developed in the two new species described herein, *M. petymbuaba* and all other species of *Moenkhausia* examined (see "examined material"). Thus, such a range of variation of those characters may constitute synapomorphies for a broader group within *Moenkhausia*.

As discussed by Lima & Zuanon (2004), the dark midlateral stripe in small characids can be categorized (without implied homology) as narrow and straight (e.g., *Hyphessobrycon cachimbensis* Travassos and *Moenkhausia petymbuaba*); broad and straight (e.g., *Moenkhausia phaenota* Fink, and *Moenkhausia heicoi* Géry & Zarske), or broad and curved (e.g., *Nematobrycon* and *Inpaichthys*). *Moenkhausia plumbea* and *M. chlorophthalma* have a broad and ventrally curved dark midlateral stripe somewhat similar to *Nematobrycon* and *Inpaichthys* except in being more diffuse.

Mirande (2009) recently criticized the uncritical acceptance of the taxonomic scheme for characids, based on Eigenmann's (1917) criteria and perpetuated by Géry (1977). Although a few species of *Moenkhausia* were included in Mirande's phylogenetic study, both analyses performed by the author refute the monophyly of the genus. In the weighted parsimony hypothesis, *Moenkhausia* is paraphyletic, with *Bario* as sister taxon to *M. sanctaefilomenae*, occupying the distalmost position in the clade. In the unweighted hypothesis, the species of *Moenkhausia* are recovered in two clades included in a large polycotomy, with *M. sanctaefilomenae* as the sister taxon of *Bario* in one of the clades, corroborating Benine (2004). However, the synapomorphies of this and all the clades located distally to node 203 (except node 220, the "Jupiaba clade") are not listed in his appendix 3, due to a composition error in the final version of the manuscript (Mirande, pers. comm.). Our examinations suggest that *Moenkhausia chlorophthalma* and *M. plumbea* appear to be closely related to *M. petymbuaba* based on the shared presence of dark blotches on the base of body scales. Nevertheless, the relationships between these species and congeners are obscure, and the group proposed herein does not conform to any previously proposed species group within the genus.

The discovery of related species of *Moenkhausia* endemic to tributaries of both the rio Xingu and rio Tapajós basins on the highest portion of the Serra do Cachimbo highlights the complexity of the river drainages in the area. Apparently, *M. chlorophthalma*, *M. petymbuaba* and *M. plumbea* have rather restricted distributions, and do not occur sympatrically. This scenario indicates that the increase in collection efforts, especially in similar creeks of isolated drainages, may result in the discovery of additional endemic species of *Moenkhausia* and other genera.

**Comparative material.** *Astyanax* sp.: MZUSP 28140 (2 c&s, 41.3-67.2 mm SL), small stream tributary to riacho do Palácio, São Francisco basin, Santana do Riacho, Minas Gerais, 19°10'S

43°41'W. *Hemigrammus unitaeniatus*: MZUSP 38713 (1 c&s, 34.5 mm SL), first tributary to rio Tarapuy, río Negro, Napo, Ecuador. *Hyphessobrycon compressus*: MZUSP 28535 (1c&s, 22.4 mm SL), Baba Creek near New Lagoon River, Oregewalk, Belize, 17°46'44"N 88°38'29"W. *Jupiaba iasy*: MZUSP 97441 (21, 26.0-40.1 mm SL, 4 c&s, 32.0-40.1 mm SL), Pará, Novo Progresso, rio Jamaxim, rio Tapajós drainage, sandy beach close to Novo Progresso, 07°03'52"S 55°26'28"W. *Jupiaba kurua*: MZUSP 96857, paratypes (70, 51.9-86.0 mm SL, 5 c&s, 56.4-77.6 mm SL), rio Curuá, rio Iriri basin, Altamira, Pará, 08°46'09"S 54°57'02"W; MZUSP 97105, paratypes (60, 45.9-82.3 mm SL, 1 c&s, 69.1 mm SL), rio Curuá, rio Iriri basin, Altamira, Pará, 08°42'28"S 54°57'12"W. *Jupiaba paranatinga*: MZUSP 95720 (3 c&s, 34.1-37.6 mm SL), rio Teles Pires, Paranaíta, Mato Grosso, 09°27'07"S 56°30'46"W. *Moenkhausia cosmops*: MZUSP 93494, holotype (43.1 mm SL), córrego 25 de Maio, tributary to rio Papagaio, rio Tapajós basin, Sapezal, Mato Grosso. MZUSP 93556 (3 c&s, 26.3-28.6 mm SL), rio Juruena, rio Tapajós basin, Sapezal, Mato Grosso, 13°14'47"S 59°00'52"W. *Moenkhausia* cf. *cotinho*: MZUSP 7274 (9, 51.7-59.9 mm SL), small stream tributary to rio Maraú, Maués, Amazonas, 03°24'S 57°42'W; MZUSP 97450 (2, 28.6-44.8 mm SL), rio Jamaxim, rio Tapajós basin, Novo Progresso, Pará, 07°03'52"S 55°26'28"W; MZUSP 62137 (1 c&s, 36.3 mm SL), rio Negro, Santa Isabel do Rio Negro, Amazonas, 00°31'S 65°01'W; MZUSP 100593 (2, 47.9-51.3 mm SL), rio Aripuanã, downstream to Dardanelos/Andorinhas rapids, Aripuanã, Mato Grosso. *Moenkhausia diamantina*: MZUSP 49236 (3, 22.0-27.8 mm SL), rio Una, rio Paraguaçu basin, Boa Vista do Tupim, Bahia, 12°58'S 40°57'W; MZUSP 86132 (1, 40.6 mm SL), rio Paraguaçu, upstream of city, Itaetê, Bahia, 12°58'25"S 40°58'20"W. *Moenkhausia diktyota*: MZUSP 62614, holotype (51.4 mm SL), small stream near Tapurucuara, Amazonas; MZUSP 93414 (1, 42.8 mm SL), small stream on Ramal 1, road to Cucuí, São Gabriel da Cachoeira, Amazonas, 00°08'S 67°05'W. *Moenkhausia lopesi*: MZUSP 82057 (1 c&s, 32.9 mm SL), ribeirão Comprido, tributary to rio Corrente, Sonora, Mato Grosso do Sul. *Moenkhausia nigromarginata*: MZUSP 45289, paratypes (5, 20.9-39.8 mm SL), small stream tributary to rio Cravari, near road MT-170, Mato Grosso. *Moenkhausia oligolepis*: MZUSP 96201 (50, 28.3-53.8 mm SL), rio Teles Pires, Paranaíta, Mato Grosso, 09°27'31"S 56°29'19"W. *Moenkhausia petymbuaba*: MZUSP 66681, paratypes (2 c&s, 22.2-33.4 mm SL), rio Curuá, Altamira, Pará, 08°44'S 54°57'W; MZUSP 97530, 335, tributary to rio Curuá, rio Iriri basin, Altamira, Pará, 08°47'03"S 54°58'29"W; *Moenkhausia pyrophthalma*: MZUSP 43372 (2, 24.3-25.8 mm SL), left margin of rio Tocantins 500 m from bridge, Porto Nacional, Tocantins, 10°43'S 48°25'W; MZUSP 45290, paratypes (7, 20.1-29.5 mm SL), stream crossing road between Água Boa and Cocalinho, rio Tocantins basin, Mato Grosso, 14°21'S 51°02'W; *Moenkhausia sanctaefilomenae*: MZUSP 96038 (3 c&s, 29.9-39.3 mm SL), rio São Francisco basin, Bahia; MZUSP 103756 (2, 27.1-37.6 mm SL), córrego Aldeia, Alto Taquari basin, Coxim, Mato Grosso do Sul, 18°28'50"S 54°40'37"W. *Tetragonopterus chalceus*: MZUSP 36814 (1 c&s, 47.9 mm SL), rio Xingu, Pará, 03°48'S 52°32'W.

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