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***Moenkhausia goya* (Characiformes: Characidae): a new species from the upper rio Tocantins basin, Central Brazil**

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Abstract

A new species of *Moenkhausia* is described from the upper rio Tocantins basin, States of Goiás and Tocantins, Brazil. *Moenkhausia goya*, new species, can be distinguished from its congeners by the shape of the humeral blotch in combination with a uniform dark pigmentation covering the interradiial membranes of the dorsal and anal fins. Among congeners, the new species is most similar to *M. britskii* Azevedo-Santos & Benine, *M. grandisquamis* (Müller & Troschel) and *M. xinguensis* Steindachner by presenting a deep body, a large, round humeral blotch and fins without discrete patches of dark pigmentation (*i.e.*, without well-defined blotches or stripes). With the description of *M. goya*, the number of species endemic to the upper rio Tocantins basin (considered upstream from the mouth of the rio Paranã) is raised to 51. Of these, some are widespread in the upper rio Tocantins basin, while others seem to be restricted to one of its sub-basins.

Key words: Cerrado, *Moenkhausia xinguensis*, State of Goiás, Taxonomy

Resumo

Uma nova espécie de *Moenkhausia* é descrita da bacia do alto rio Tocantins, Estados de Goiás e Tocantins, Brasil. *Moenkhausia goya*, espécie nova, pode ser distinguida de suas congêneres pela forma da mancha umeral em combinação com uma pigmentação escura uniforme recobrimdo as membranas inter-radiais das nadadeiras dorsal e anal. Entre as congêneres, a nova espécie é mais similar a *M. britskii* Azevedo-Santos & Benine, *M. grandisquamis* (Müller & Troschel) e *M. xinguensis* Steindachner por ter um corpo alto, uma mancha umeral grande e redonda e nadadeiras sem áreas de pigmentação escura discretas (*i.e.*, sem manchas ou listras bem definidas). Com a descrição de *M. goya*, o número de espécies endêmicas à bacia do alto rio Tocantins (considerada à montante da barra do rio Paranã) sobe para 51. Destas, algumas estão amplamente distribuídas na bacia do alto rio Tocantins, enquanto outras parecem estar restritas a uma de suas sub-bacias.

Palavras-chave: Cerrado, Estado de Goiás, *Moenkhausia xinguensis*, Taxonomia

Introduction

Moenkhausia Eigenmann (1903) was proposed having as its type-species *Tetragonopterus xinguensis* Steindachner

and was defined as follows: “Similar to *Markiana*. Anal naked, caudal scaled”. Subsequently, Eigenmann (1917) redefined the genera in Characidae (diagnostic characters are summarized in his “Key to the genera”), thus distinguishing *Moenkhausia* from each of the following genera by a single character: *Astyanax* Baird & Girard by the presence of small scales covering the base of caudal fin (*vs.* absence); *Hemigrammus* Gill by the complete lateral line (*vs.* incomplete); *Markiana* Eigenmann, by the presence of a single row of scales covering the base of the anal fin (*vs.* presence of several series of scales forming a broad sheet that covers the proximal half of the fin); and *Tetragonopterus* Cuvier by having the lateral line slightly curved downward anteriorly (*vs.* marked downward curvature).

The polyphyletic nature of *Moenkhausia* has long been suspected by several authors, one of the reasons being the striking similarity in color pattern between some of its species and other characids: *e.g.*, *M. hemigrammoides* Géry and *Hemigrammus unilineatus* Gill (Géry, 1965), *M. phaeonota* Fink and several *Hyphessobrycon* species (Fink, 1979), and the *M. collettii* species group and the *He. lunatus* species group (Ota *et al.*, 2014). In fact, the polyphyly of the genus has been confirmed by phylogenetic studies (see Benine, 2004; Mirande, 2018; Mariguela *et al.*, 2013). The polyphyletic nature of the genus precludes a proper cladistic classification of new species. Therefore, awaiting a phylogenetic diagnosis for the genus, several species have been described in *Moenkhausia* (which presently includes 90 species) based on the combination of characters proposed by Eigenmann (1903, 1917) (*e.g.*, Marinho, 2010; Sousa *et al.*, 2010; Bertaco *et al.*, 2011; Pastana & Dagosta, 2014; Petrolli *et al.*, 2016; Ohara & Marinho, 2016), or either because they were thought to be related to other species previously described in the genus (*e.g.*, Benine *et al.*, 2009; Dagosta *et al.*, 2015; Ohara & Lima, 2015).

Recent expeditions to the upper rio Tocantins basin, along with material deposited in several fish collections, allowed us to assemble a large amount of material of a new species, which we describe within *Moenkhausia*. The new species closely resembles some of the high-bodied *Moenkhausia* species, such as the recently described *M. britskii* Azevedo-Santos & Benine, *M. grandisquamis* (Müller & Troschel) and the type species of the genus, *M. xinguensis* Steindachner.

Material and methods

Morphometric and meristic data were taken following Fink & Weitzman (1974), with the addition of the head depth, which is measured as a vertical line from tip of supra-occipital process to ventral profile of body; also, the scale rows below lateral line were counted to the pelvic-fin base instead of the anal-fin base. In the description, the frequency of each count is given in parentheses; holotype counts are marked with an asterisk. Cleared and stained (c&s) specimens, of which vertebral and unbranched anal-fin ray counts were taken, were prepared following Taylor & Van Dyke (1985). The Weberian apparatus was counted as four vertebrae; the fused preural and ural centra PU1+U1 were counted as one element. Additional comparative material is the same listed in Azevedo-Santos & Benine (2016) and Dagosta & Marinho (2016). Institutional acronyms are listed in Sabaj (2016).

Results

Moenkhausia goya, new species

(Figs. 1–4)

Holotype. MCP 51734, 60.5 mm SL, Brazil, Goiás, Pirenópolis, ribeirão Dois Irmãos, trib. rio das Almas, rio Maranhão basin, 15°42'50"S 49°2'39"W, elevation 713 m, O. Vitorino, 20 Feb 2017.

Paratypes. All from Brazil, upper rio Tocantins basin. **Goiás.** LBP 23678, 2, 42.0–44.4 mm SL; LBP 23679, 3, 39.4–47.8 mm SL Pirenópolis, ribeirão das Araras, trib. rio do Peixe, rio Maranhão basin, 15°42'15"S 49°2'12"W, elevation 722 m, O. Vitorino & G. C. Deprá, 12 Dec 2016. NUP 19099, 3, 35.1–41.8 mm SL, same locality and collector as LBP 23678, 20 Feb 2017. NUP 19100, 2, 56.2–61.9 mm SL, collected with holotype. LBP 23680, 2 c&s, 42.2–51.8 mm SL; NUP 19104, 17, 39.1–63.0 mm SL, same locality and collector as holotype, 23 Apr 2017. MCNIP 1827, 2, 33.1–49.3 mm SL, Pirenópolis, córrego Limoeiro, trib. ribeirão Dois Irmãos, rio Maranhão basin, 15°43'47"S 49°2'28"W, elevation 737 m, O. Vitorino & G. C. Deprá, 15 Aug 2016. MCP 44632,

3, 48.9–59.6 mm SL, Itapaci, rio São Patricinho, trib. rio das Almas, rio Maranhão basin, 14°56'44"S 49°32'49"W, F. L. Garro, 16 Aug 2008. MNRJ 12655, 1, 61.0 mm SL, Niquelândia, rio do Peixe, rio Maranhão basin, G. W. Nunan & D. F. Moraes Júnior, 8 Oct 1985. MNRJ 12665, 19, 17.3–44.8 mm SL, Niquelândia, rio do Peixe, rio Maranhão basin, G. W. Nunan & D. F. Moraes Jr., 8 Oct 1985. MNRJ 12692, 98, 22.6–58.6 mm SL, Niquelândia, córrego Barriguda, trib. rio Bagagem, rio Maranhão basin, G. W. Nunan & D. F. Moraes Jr., 15 Oct 1985. MZUSP 53970, 18, 32.5–61.9 mm SL, Niquelândia, córrego Piqui, trib. rio do Peixe, rio Maranhão basin, 14°17'0"S 48°55'0" W, M. T. Rodrigues *et al.*, May 1996. NUP 9273, 4, 56.0–61.0 mm SL, Goiás, córrego Brumado, trib. rio Uru, trib. rio das Almas, rio Maranhão basin, 15°48'51"S 49°50'36"W, elevation 658 m, D. S. Mendonça, 15 Feb 2009. NUP 19102, 4, 46.5–55.9 mm SL, Pirenópolis, ribeirão Dois Irmãos, rio Maranhão basin, 15°42'50"S 49°2'54"W, elevation 703 m, O. Vitorino, 23 Apr 2017. NUP 19192, 1, 50.6 mm SL, Planaltina, rio Arraial Velho, rio Maranhão basin, 15°4'31"S 47°55'43"W, elevation 672 m, T. Debona, Aug 2016. ZUEC 6414, 3, 52.6–60.6 mm SL, Niquelândia, rio Traíras, rio Maranhão basin, 14°36'32"S 48°28'44"W, T. C. Pessali & G. E. da Silva, 25–28 May 2011. MNRJ 13075, 52, 26.6–56.2 mm SL, Minaçu, unnamed tributary of córrego Lageado, trib. rio Tocantins, 13°38'S 48°19'W, D. F. Moraes Júnior, 16 Jan 1988. MNRJ 13167, 1, 42 mm SL, Minaçu, 1, 42 mm SL, unnamed stream between córrego do Ginho and córrego Mutum, trib. rio Tocantins, D. F. Moraes Jr., 27 Dec 1987. MZUSP 113978, 37 21.7–57.3 mm SL, 2 mol, Colinas do Sul, ribeirão São Joaquim, trib. rio Preto, 14°13'6.2"S 47°55'28.7"W, O. Oyakawa, A. Zanata, P. Camelier & M. Melo, 29 Nov 2012. MZUSP 114355, 2, 16.2–23.7 mm SL, Colinas do Sul, rio Preto, trib. rio Tocantins, 13°59'40"S 47°55'43.1"W, O. Oyakawa, A. Zanata, P. Camelier & M. Melo, 29 Nov 2012. MZUSP 40705, 117, 22.4–51.2 mm SL, Monte Alegre de Goiás, rio Bezerra, rio Paranã basin, 13°15'0"S 46°43'48"W, J. C. Oliveira & W. J. M. Costa, 22 Sep 1988. **Tocantins.** MZUSP 113843, 119, 22.0–56.6 mm SL, Arraias, rio Bezerra, rio Paranã basin, 13°1'1"S 46°49'43.5"W, F. Dagosta, J. L. Birindelli, M. Loeb & Santos, 1 Dec 2012.



FIGURE 1. *Moenkhausia goya*, holotype, MCP 51734, 60.5 mm SL, Brazil, Goiás, Pirenópolis, rio das Almas basin.

Diagnosis. *Moenkhausia goya*, new species, can be distinguished from most congeners, except *M. britskii*, *M. conspicua* Soares & Bührnheim, *M. grandisquamis*, *M. ortegasae* Fowler, *M. rubra* Pastana & Dagosta, *M. venerei* Petrolli, Azevedo-Santos & Benine and *M. xinguensis*, by the presence of a single round, relatively large humeral blotch. It can be readily distinguished from *M. rubra* by the absence of distinct dark pigmentation in the anteriormost anal-fin rays (*vs.* unbranched and first to fifth anteriormost branched anal-fin rays dark, especially distally), from *M. conspicua* and *M. venerei* by the absence of a black line along anal-fin base (*vs.* presence) and from *M. ortegasae* by the caudal fin hyaline or covered with scattered melanophores, but without distinct patches

of dark pigmentation (*vs.* tip of caudal-fin lobes dark). It can be distinguished from *M. britskii*, *M. grandisquamis* and *M. xinguensis*, the most similar species, as well as from most other congeners, by having a dense pigmentation in the anal and dorsal fins, consisting of melanophores uniformly distributed over the interrational membranes throughout the fins (*vs.* fins hyaline). Additionally, *Moenkhausia goya* is distinguished from *M. britskii* and *M. grandisquamis* by having straight *radii* on the flank scales (*vs.* bent *radii*; see Azevedo-Santos & Benine, 2016, Fig. 2) and from *M. xinguensis* by having a larger humeral blotch, almost as broad as the eye (*vs.* about half as broad as the eye) and a thinner longitudinal dark stripe on body with fading edges, usually not retaining guanine when preserved (*vs.* longitudinal dark stripe wider, with sharp edges, frequently retaining guanine when preserved).

Description. Morphometric data in Table 1. Greatest body depth at dorsal-fin origin. Dorsal profile slightly convex from tip of snout to interorbital region, straight to slightly concave along interorbital region, convex to dorsal-fin base, straight along dorsal-fin base, slightly convex to adipose fin, and concave along caudal peduncle. Ventral profile markedly convex from tip of dentary to anal-fin base, roughly straight along anal-fin base, and concave along caudal peduncle.

TABLE 1. Morphometric data of the holotype and 36 paratypes of *Moenkhausia goya*, new species. SD = standard deviation. Range includes the holotype.

	Holotype	Range	Mean	SD
Standard length	60.5	32.9–61.5	-	-
Percents of standard length				
Greatest body depth	46.4	37.2–49.4	46.3	2.54
Snout to dorsal-fin origin	50.2	50.0–54.7	52.5	1.25
Snout to pectoral-fin origin	27.8	26.4–32.2	28.9	1.24
Snout to pelvic-fin origin	47.9	47.7–53.3	49.8	1.42
Snout to anal-fin origin	65.5	61.9–72.3	66.1	1.98
Caudal peduncle depth	12.9	9.5–13.8	12.6	0.80
Caudal peduncle length	11.9	8.7–14.8	12.0	1.46
Pectoral-fin length	24.8	20.1–26.9	24.2	1.40
Pelvic-fin length	20.0	16.8–21.7	19.6	1.17
Dorsal-fin length	32.2	29.6–35.6	32.7	1.51
Dorsal-fin base	15.7	12.2–17.2	15.1	0.83
Anal-fin length	19.3	17.6–23.5	20.3	1.50
Anal-fin base	33.1	30.2–34.5	32.4	1.18
Eye to dorsal-fin origin	37.2	33.9–40.4	36.8	1.31
Dorsal-fin origin to caudal-fin origin	56.6	53.0–61.0	56.0	1.61
Head length	28.4	25.5–30.6	27.8	1.09
Head depth	36.4	32.2–39.5	36.4	1.66
Percents of head length				
Snout length	24.4	23.5–30.9	26.7	1.81
Upper jaw length	41.3	37.7–51.8	42.4	2.47
Horizontal orbital diameter	41.3	41.3–53.5	45.8	2.60
Least interorbital width	34.9	31.8–37.6	35.4	1.39

Pre-pelvic region somewhat flattened, mainly at pelvic-fin insertion. Head and trunk compressed, somewhat ovoid in cross-section, broader dorsally. Greatest width just posterior to supracleithrum. Dorsal fin at middle of standard length, its base about half distance between end of dorsal fin and adipose fin. Adipose fin slightly anterior to end of anal fin base. First unbranched anal-fin ray at vertical through last dorsal-fin ray. Tip of pectoral fin falling short of pelvic-fin base. Tip of pelvic fin falling short of anal-fin base. Pelvic-fin insertion slightly anterior to vertical through first dorsal-fin ray, close to ventral profile of body. Head somewhat deeper than long. Nostril

approximately at horizontal through dorsal margin of pupil. Orbit mostly in anterior half of head length and dorsal half of head depth. Infraorbital 3 contacting preopercle ventrally and posteriorly or falling short from it. Dorsal end of branchial opening slightly ventral to horizontal through dorsal margin of orbit.



FIGURE 2. *Moenkhausia goya*, paratype, MZUSP 113978, 54.0 mm SL, Brazil, Goiás, Colinas do Sul, rio Preto basin.



FIGURE 3. Live coloration of *Moenkhausia goya*, LBP 23679, 47.8 mm SL, Brazil, Goiás, Pirenópolis, rio das Almas basin.

Mouth terminal, isognathous. Posterior tip of maxilla at vertical through anterior margin of pupil and middle of infraorbital 2. Premaxillary teeth arranged in two rows; outer row with 4*(15), 5(19) tricuspidate teeth with central cusp larger; inner row with 4(2), 5*(32) pentacuspidate teeth with central cusp larger (Fig. 4). Maxilla with 1(6), 2*(43), 3(4) pentacuspidate teeth. Dentary with 4*(52), 5(1) large, tetracuspidate teeth with central cusp larger, followed by eight small, uni- to tricuspidate teeth decreasing in size posteriorly.

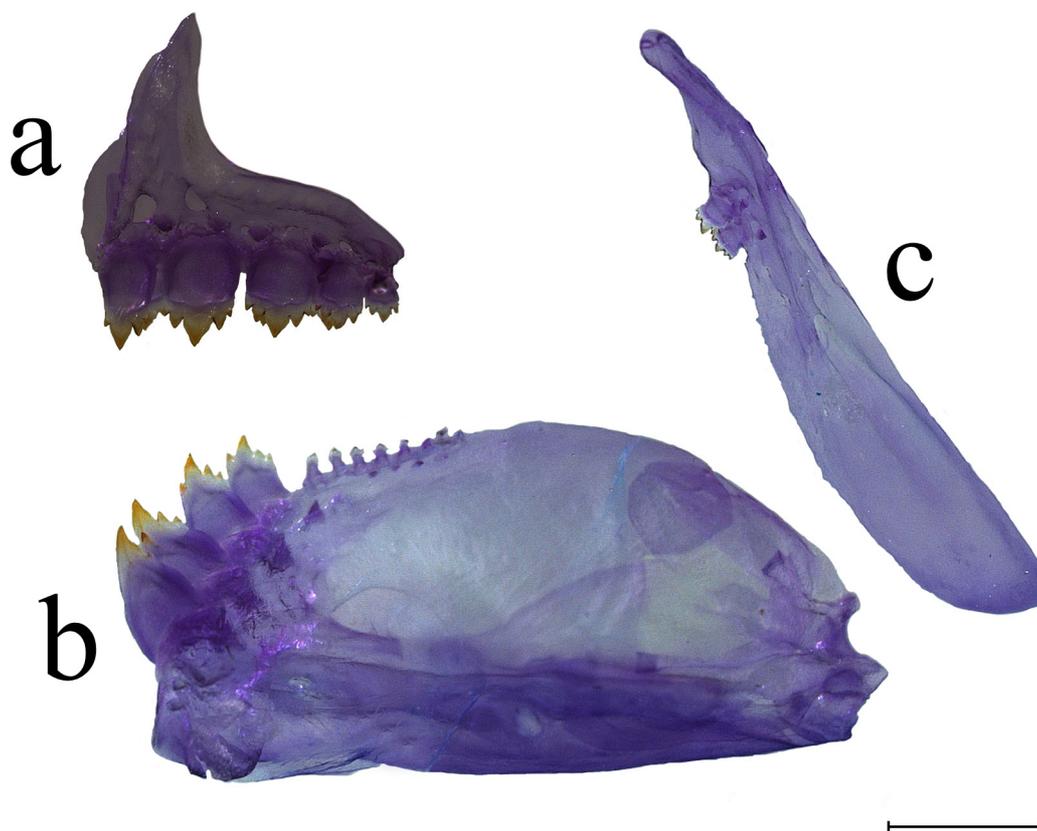


FIGURE 4. Medial view of right side of upper and lower jaws of *Moenkhausia goya*, LBP 23680, 42.2 mm SL. Scale bar = 0.5 mm.

Dorsal-fin rays ii, 8(3), 9*(49), 10(1). Anal-fin rays iii(1), iv(1), 21(1), 22(3), 23(39), 24(13), 25(7), 26(1). Pectoral-fin rays i, 9(8), 10(13), 11*(16), or 12(15). Pelvic-fin rays, i, 7*(34). Adipose fin present.

Scales cycloid. About 2–10 straight radii in each scale. Lateral line slightly curved, complete, with 31(4), 32(15), 33*(11), 34(15), or 35(1) pored scales. Transversal scales above lateral line 5*(52), 6(1); below lateral line, 4(46), 5*(7). Pre-dorsal scales 8(7), 9*(22), 10(1). Circumpeduncular scales 14*(37). A single scale row covering base of first unbranched to 13th–23rd branched anal-fin rays. Small scales covering the proximal two thirds of caudal-fin lobes.

Total vertebrae 33(2). Upper-branch gill rakers 5(1), 6(9), 7(18) or 8(4), lower-branch 8(1), 9(6), 10(18) or 11(7).

Color in alcohol. Background yellowish to tan. Dorsal surface of head dark brown, including upper jaw. Tip of lower jaw dark brown. Poorly preserved paratypes (NUP 9273) with infraorbital series and opercular bones retaining guanine. Melanophores scattered on infraorbital bones, close to ventral margin of eye. Melanophores all over opercle, mainly on its dorsal half. Body darker dorsally than ventrally. Melanophores on body scales forming reticulate pattern, especially on dorsal half; abdominal region lacking melanophore patterning. Reticulate pattern formed by melanophores distributed along margin of scales, especially on posterior margin. Reticulate pattern much less conspicuous in smaller specimens. Concentration of melanophores higher dorsally to anal-fin base than over ribs. Melanophores occasionally outlining myosepta dorsally to anal-fin base. Humeral blotch large, rounded, immediately dorsal to second to fourth lateral-line scales, covering about two or two and a half scale rows vertically. Dark-brown lateral band, its anterior end connecting with posterodorsal margin of humeral spot, and its posterior end on bases of median caudal-fin rays. Anterior end of lateral band narrow, occasionally diffuse. Lateral band broader and more conspicuous towards caudal peduncle, about one-scale deep at vertical through base of first dorsal-fin ray, one and a half-scale deep between vertical through last dorsal-fin ray and vertical through adipose fin, one scale deep ventrally to adipose fin and broadening to form three-scale deep lozenge-shaped mark on distal half of caudal peduncle. Lateral band located two scale rows dorsally to lateral line on anterior portion of body, one

scale row on middle portions, and immediately dorsal to lateral line at posterior portion. Melanophores on lateral band more concentrated along horizontal myoseptum. Humeral blotch distinctly larger in adults. Lateral band broader and more conspicuous in adults. Poorly preserved non-type specimens (NUP 9273) with lateral band retaining guanine. Pectoral and pelvic fins hyaline. Dorsal, caudal and anal fins with hyaline rays and interradial membranes densely covered with melanophores. High concentration of melanophores mainly on basal portions of anal fin, except at distal portion of first anal-fin rays. Young specimens with vertical fins less dark than in adults.

Color in life. Similar to color in alcohol except in the following details (Figs. 2, 3): Head yellowish dark brown dorsally, silver laterally and ventrally. Abdominal region silvery. Dorsal portion of eye tan. Longitudinal stripe yellowish silver. Dorsal portion of body olive to plumbeous. Fins with light yellowish to reddish background, mainly the basal two-thirds of caudal fin. Distal portion of anal-fin anteriormost rays white.

Etymology. *Moenkhausia goya* is named after the Goyá, a South American ethnic group that lived in the central region of Brazil, which resisted to the encroachment of their territories until the 19th century. They also originated the name of the state of Goiás, where most of the distribution of the new species lies.

Geographic distribution. *Moenkhausia goya* is known from the upper rio Tocantins basin (*sensu* Ribeiro *et al.*, 1995), at the rio Maranhão and rio Paranã basins and in streams draining directly into the rio Tocantins upstream of its meeting with the rio Paranã (Fig. 5), states of Goiás and Tocantins, Brazil.

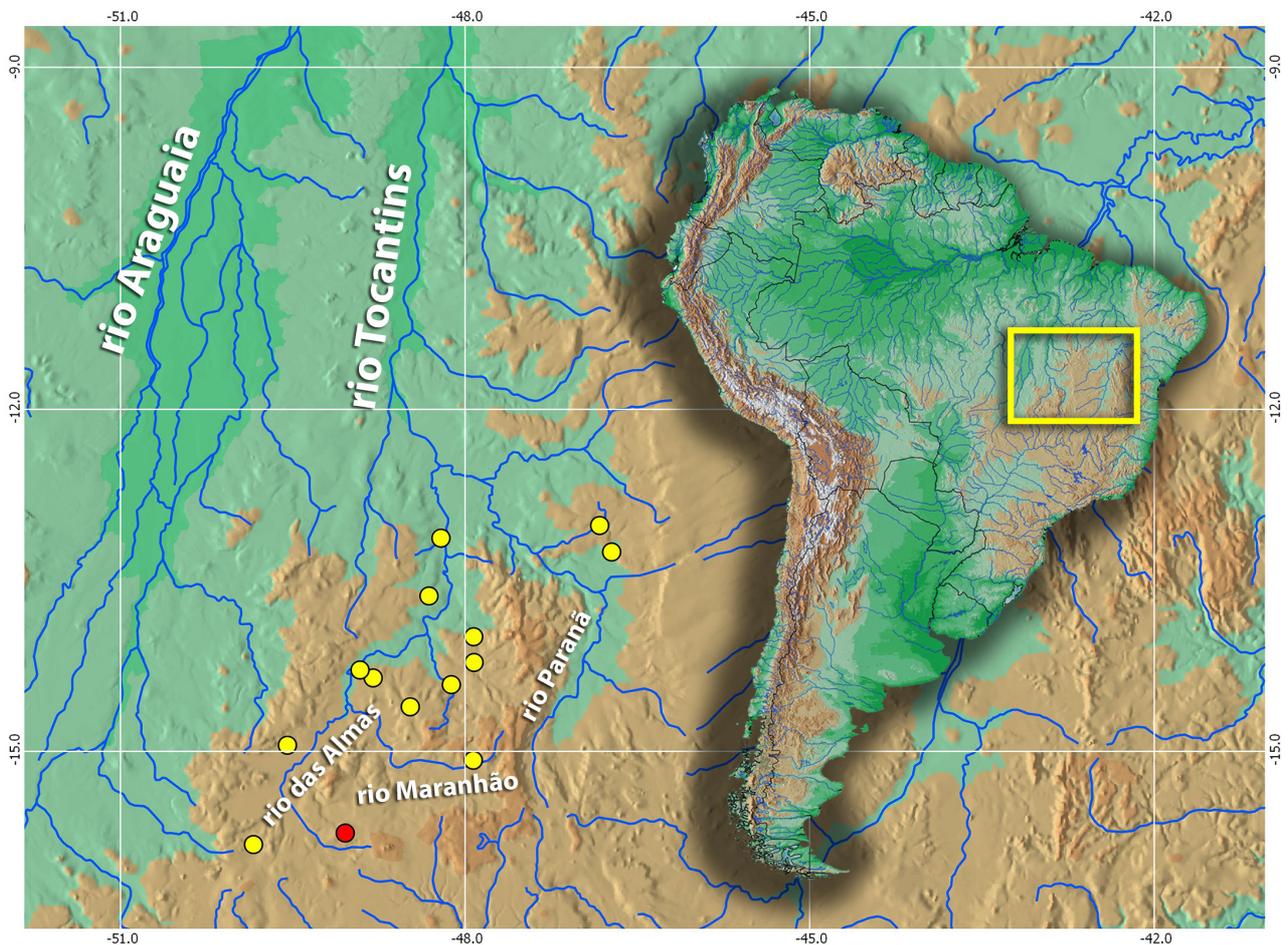


FIGURE 5. Map of upper rio Tocantins basin and adjoining areas showing the distribution of *Moenkhausia goya*. Red spot represents the type locality, yellow spots represent collecting sites of remaining lots. One symbol may represent more than one locality.

Conservation status. *Moenkhausia goya* is so far known from the upper rio Tocantins basin, where it is widely distributed. Despite existing some riparian forest degradation for pasture in several sites where the species occurs, it seems not to preclude its presence. Therefore, *M. goya* would be classified as Least Concern (LC) following the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN Standards and Petitions Subcommittee, 2017).

Habitat and ecological notes. *Moenkhausia goya* occurs in lotic environments, generally shallow streams, shaded by riparian vegetation. It is also noteworthy that there seems to be a shift of habitat use by the species related to hydrological variability in creeks and riffles where it occurs. During the drier seasons, *M. goya* is more common in riffles, while during the rainy season it prefers the pool habitats where the water flow is less intense. Specimens with more vivid color in life were more often observed during the dry season, probably related to increase in the sexual activity of the species during this period.

Discussion

As stated before, the relationships of *Moenkhausia goya* may be among other species of *Moenkhausia* that share similar body shape and coloration, such as *M. britskii*, *M. grandisquamis*, and *M. xinguensis*. The recent phylogenies by Mariguela *et al.* (2013) and Mirande (2018) showed that the genus *Moenkhausia* is paraphyletic. For the moment we defer any consideration on the putative phylogenetic relationships of the new species to future, broader phylogenetic analyses of the genus *Moenkhausia* and related genera.

As suggested by Bertaco & Carvalho (2010), the upper rio Tocantins basin, including the stretch of the rio Tocantins basin upstream of its junction with the rio Paranã, seems an important biodiversity hotspot. The number of endemic species assigned to the basin is still increasing, and after the compilation made by these authors (then including 37 species), the following taxa were described from the region: *Apteronotus camposdapazi* Santana & Lehmann, *Aspidoras mephisto* Tencatt & Bichuette, *Astyanax courensis* Bertaco, Carvalho & Jerep, *Bryconops tocantinensis* Guedes, Oliveira & Lucinda, *Ctenocheirodon pristis* Malabarba & Jerep, *Gymnotocinclus canoeiro* Roxo, Silva, Ochoa & Zawadzki, *Hemigrammus tocantinsi* Carvalho, Bertaco & Jerep, *Ituglanis boticario* Rizzato & Bichuette, *Ituglanis epikarsticus* Bichuette & Trajano, *Ituglanis passensis* Fernández & Bichuette, *Ituglanis ramiroi* Bichuette & Trajano, *Microglanis maculatus* Shibatta, *Moenkhausia aurantia* Bertaco, Jerep & Carvalho, *Moenkhausia dasalmas* Bertaco, Jerep & Carvalho, *Nannoplecostomus eleonora* Ribeiro, Lima & Pereira, *Retroculus acherontos* Landim, Moreira & Figueiredo and *Steindachnerina notograptos* Lucinda & Vari. Therefore, currently it is possible to recognize 51 species exclusive to the region, excluding *Hypostomus ericae* Carvalho & Weber (cf. Zawadzki & Carvalho, 2014) and *Moenkhausia tergimacula*, which also occur in the rio Araguaia basin (NUP 8243).

Not all species of this list have the same distribution pattern. Some of them are restricted to the rio Paranã basin, others to the rio das Almas and some occur in both basins, as in the case of *Moenkhausia goya*. These distinct patterns may indicate that there is still much to be studied about the distribution of fishes in the upper rio Tocantins or even that there are several physiographic subunits within the limits defined as upper rio Tocantins by Ribeiro *et al.* (1995).

Other authors, considering broader hydrographical limits, discussed the fish endemism in the rio Tocantins basin. Dagosta & de Pinna (2017, supplementary material) recognized at least 70 endemic species in the upper rio Tocantins (considered upstream from the mouth of the rio Araguaia). Albert *et al.* (2011), considering the whole Araguaia-Tocantins basin, listed 153 exclusive species. Regardless of the hydrographic boundaries employed, all these data reveal that the region has a high diversity and should receive special attention of governmental environmental agencies given the intense riparian forest degradation for pasture and the presence of several large river dams (*e.g.*, Serra da Mesa), which may represent ecological barriers to the gene flux between populations of different tributaries.

Comparative material examined

Moenkhausia aurantia: MZUSP 107827, 8 paratypes, 27.7- 40.0 mm SL; MZUSP 113835, 25, 33.0-49.5 mm SL: Brazil, Goiás, rio Tocantins basin. *Moenkhausia tergimacula*: NUP 8243, 1, 54.0 mm SL: Brazil, Pará, rio Araguaia.

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