Abstract

*Moenkhausia heikoi*, a new endemic tetra from the Rio Xingu basin, is described and compared with related species, including the type species of the genus *Moenkhausia xinguensis*, which is phenotypically close and also endemic to the Xingu basin. The latter species is redescribed from the holotype and from new collections.

Introduction

The bed of the Rio Xingu, the lowest southern tributary of the Amazon (excluding the Rio Tocantins, which empties into the delta), is very rocky. Navigation is therefore very difficult, though recently the lower course by the Trans-Amazonian highway and the uppermost reaches (Rio Suia Missu basin) by the Serra do Roncador road have been made more accessible. The rest is practically unexplored and inhabited only by Amerindians. This explains why its highly endemic fauna, which has Guianan affinities, is so poorly known.

The new characid described below is an attractive South American tetra. Although its colours are less vivid than those of the famous neon tetras, it will certainly become of interest to the scientific community and to aquarists if its propagation is accomplished. Owing to the relative difficulty of access to its habitat, this characid was only discovered in 1975, near Altamira, during an expedition by the brothers H. and M. Bleher, with H. Baensch, along the then newly-opened Trans-Amazonian highway. The specimens preserved at that time were lost. The species was rediscovered by B. Killian, U. Schliewen, and R. Stawikowsky in 1988 (Stawikowsky, 2001). Some specimens were preserved, and three of them were examined by the senior author. However, the specimens were much too small to be useful for description of the species. Eventually, H. Bleher succeeded in collecting adult specimens. Some of them were studied in the aquarium for a few months, though attempts at breeding were unsuccessful. A few others were preserved and are described here.

Material and methods

Counts and proportions follow Géry (1972a & b); measurements were made with electronic callipers; head was measured without opercular membrane, and its depth at level of posterior margin of eye; snout was measured in projection, i.e. as if its tip and mar-
gin of eye were on the same plane. As only a small number of specimens were available, and none could be cleared and stained, but an X-ray was taken of the 3 largest specimens (Fig. 3). Counts for the unbranched fin rays (usually soft in Characiformes) are given in small Roman numbers. The proportions shown in Table II are given as percentages of standard length (SL) (rounded to the nearest 0.05), and in the text in classic form for comparison and discussion.

The adjective syntopic means “occurring in the same locality” (Sedlag, U. & E. Weinert, 1987); aff. Is the current abbreviation for affinis (related to); cf. Is the current abbreviation for confer (to compare with).

Where specimens have been deposited the following abbreviations have been used:

*Moenkhausia heikoi* n. sp. (Fig. 1-9)

**Holotype:** MZUSP no. 83536, 47.80 mm SL: Rio Iriri, a left-hand tributary of the Rio Xingu well above Altamira, among rocks in 2.5 m depth at the edge of an island between Rio Novo and Igarapé Grotá, ca. 10 km below mouth of R. Novo, State of Pará, Brazil, co-ordinates approximately 4°25’ S 53°40’ W. Collected with a large (50 m x 6 m) seine and dip nets by H. Bleher and N. Khardina, July, 2002.

**Paratypes:** Collected with the holotype (same data): MTD F no. 27909, 44.20 mm SL (specimen 2 in Table I); 1, MHNG no. 2644.30, 43.85 mm SL (spec. 3 in Table I); 2, pers. coll. J. Géry no. 1063.1-2.2003, 39.20 and 34.55 mm SL (specs. 4 and 5 in Table I).

**Non-paratype:** 1 post-larva, pers. coll. J. Géry no. 1063.3.2003, about 17.5 mm SL, taken near the Ilha Grande do Iriri at the western border of the Amerindian reserve, collected with dipnet by H. Bleher July, 2002.

**Diagnosis**

*A Menonkhausia* intermediate, in the body depth, between the elongate species and the type species group (*M. xinguensis*, revised at the end of this paper), with the dorsal and pelvic fins well forward of mid-body, a short head almost as deep as long, a large eye (2.30-2.60 in head length) and a relatively short snout (ca. 4.5 to 5.6 times in head length, in pro-

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jection); characterized chiefly by its black body pattern, similar to that of Moenkhausia phaeonota and tetras of other groups such as Hyphessobrycon herbertaxelrodi (the so-called black neon).

**Description**
See Table II for proportions as percentages of SL and head length for the 5 typical specimens.
A tetra of moderate size: largest specimen about 60 mm total length, with specimens of more than 70 mm observed by the collector while diving; body oval, only moderately elevated and compressed, tapering posteriorly, greatest depth in front of dorsal fin, 2.60 (holotype) to 3.0 (smallest paratype) in SL, up to 2.50 in SL measured on photographs of large females; dorsal fin very distinctly anterior to mid-body, 1.17 (smallest paratype) to 1.27 (holotype) in postdorsal and 2.0-2.16 in SL; predorsal region forming an open V in section; pelvic fin insertion about one scale anterior to first dorsal ray, prepelvic distance 1.29-1.41 in post-

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**Fig. 3.** Radiographs of Moenkhausia heiko n. sp. Above: MTD F 27909 (paratype), middle: MHNG 2644.30 (paratype), below: MZUSP 83536 (holotype). Photo by A. Zarske.
pelvic and 2.13-2.41 in SL; belly rounded, but flat anteriorly to pelvic fins; fins without filaments, none very elongate, pectorals and pelvics just reaching next respective fin (pelvics not quite reaching first anal rays in some specimens); anal fin without distinct anterior lobe, its base covered on proximal half by single row of small scales. Moderate-sized adipose fin present; caudal peduncle short and deep, its depth 1.15-1.43 in its length and 8.85-12.35 in SL; caudal with more or less pointed lobes, scaled on proximal half of lobes immediately following preservation of specimens (scales probably fragile and easily lost), only some scales on lower lobe in holotype (after several months in the aquarium).

Head particularly deep and short, length (without membrane) 3.60-3.95 in SL, as deep as long, depth 1.0-1.1 in its length; bony interorbital 3.15-3.20 in head length; eye large, 2.30-2.60 in head length (2.10 to 2.40 measured on photographs); maxilla of moderate length and rather narrow, extending to level of anterior margin of eye or somewhat further, 3.25-3.70 in head length; snout short, rounded, about 4.5 to 5.6 times in head length; mouth terminal or barely oblique, its anterior opening at level of centre of eye; fontanelles narrow and long, from level of anterior margin of pupil to supraoccipital; great infraorbital (the third, commonly abbreviated as SO3) increasing in size with age, covering less than 2/3 of cheek in smallest paratype, almost contacting subopercular canal at angle and leaving small triangle anteriorly and posteriorly in holotype; postorbitals present, but uppermost (6th circumorbital) reduced to its canal.

Scales cycloid, of typical structure, i.e. with a few slightly diverging radii, not curved up and down as in Moenkhausia grandisquamis; lateral line always complete (except in post-larva where scales are simply indented posterior to dorsal fin), and only weakly curved (convexity towards abdomen); 34 pored scales; 10 or 10 1/2 transverse scales from dorsal to pelvic, formula 5/4 or 4.1/2; 7.1/2 or 8 predorsal scales in a regular series, 13 or 14 around caudal peduncle.

Dorsal fin with 2 anterior unbranched rays and 8 branched rays; 10 pterygiophores, the first between 4th and 5th neural spines (counted on radiograph, n=3); anal fin with 3 or 4 anterior unbranched and 23-26 branched rays, without sexual hooklets; 26-27 pterygiophores (2 ex.: 26.1 ex.: 27), first two between 3rd and 4th haemal spines (counted on radiograph); pectoral fins with i,14 rays, pelvic fins with i,7(i); 33-34 vertebrae, including 4+8-9 precaudal (2 ex.: 8, 1 ex.: 9) and 21 caudal (counted on radiograph).

Premaxilla with 3-4 tricuspid teeth in regular outer row on each side, separated by median hiatus, and 5 quincuspid teeth in inner row; maxilla with 3-4 quincuspid to tricuspid teeth at the angle; lower jaw with 4 large quincuspid frontal teeth followed by one tooth of intermediate size and 12 small tricuspid to conical.

Table I. The morphometric differences between related Moenkhausia species and Moenkhausia heikoi n. sp.

<table>
<thead>
<tr>
<th></th>
<th>M. takasei</th>
<th>M. lopesi</th>
<th>M. phaeonota</th>
<th>M. heikoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (%SL)</td>
<td>27.5-31.0</td>
<td>27.0-35.7</td>
<td>25.6-35.5</td>
<td>33.1-38.4</td>
</tr>
<tr>
<td>Eye in adult head</td>
<td>ca. 2.55</td>
<td>2.25-2.55</td>
<td>ca. 2.55</td>
<td>ca. 2.30</td>
</tr>
<tr>
<td>Colour</td>
<td>white</td>
<td>yellow?</td>
<td>red</td>
<td>gold</td>
</tr>
<tr>
<td>Tr. scales.</td>
<td>5/3.1/2-4</td>
<td>5-6/4-5</td>
<td>5/4</td>
<td>5/4-4.1/2</td>
</tr>
<tr>
<td>Anal rays (total)</td>
<td>22-24</td>
<td>22-26</td>
<td>24</td>
<td>26-30</td>
</tr>
</tbody>
</table>

Table II. Proportions of the holotype and paratypes of Moenkhausia heikoi n. sp., No. 1-5, No. 1 is the holotype, MZUSP 83539; and of 4 examples of Moenkhausia xinguensis, No. 6-9, No. 6 is the holotype, NMW 57826 (in % of the standard length except for the head structures which are % of the head length; peduncle = depth of peduncle).

<table>
<thead>
<tr>
<th>Moenkhausia heikoi</th>
<th>Moenkhausia xinguensis</th>
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<tbody>
<tr>
<td>SL (mm)</td>
<td></td>
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<tr>
<td>Depth</td>
<td></td>
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<tr>
<td>Predorsal</td>
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<td>Prepelvic</td>
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<td>Peduncle</td>
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<td>Eye</td>
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<td>Interorbital</td>
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<td>Maxilla</td>
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<td>Snout</td>
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</table>

Table III. Proportions of the holotype and paratypes of Moenkhausia heikoi n. sp., No. 1-5, No. 1 is the holotype, MZUSP 83539; and of 4 examples of Moenkhausia xinguensis, No. 6-9, No. 6 is the holotype, NMW 57826 (in % of the standard length except for the head structures which are % of the head length; peduncle = depth of peduncle).
Fig. 4. Adult female *Moenkhausia heiko* n. sp., in aquarium more than 12 months after capture. Approximate TL 65.0 mm. Photo by N. Khardina.

Fig. 5. Adult male *Moenkhausia heiko* n. sp., in aquarium more than 12 months after capture. Approximate TL 70.0 mm. Photo by N. Khardina.

Fig. 6. Semi-adult male *Moenkhausia heiko* n. sp. immediately after capture. 47 mm SL. Photo by N. Khardina.

Fig. 7. Juvenile *Moenkhausia heiko* n. sp., captured in the Rio Iriri among submerged roots, unlike semi-adult and adults which were found down among rocks at a depth of 2.5 m. 25.0 mm SL. Photo by H. Bieher.
Moenkhausia heikoi n.sp., a new tetra from the Rio Xingú basin, Brazil, with a supplementary description of the genus type species

Fig. 8. *Moenkhausia heikoi* n. sp. type locality in the Rio Iriri. The species lives with some syntopic species in strong current between the rocks, at depths of up to 2.5 m (see Figs. 10-22). Photo by H. Bleher.
insufficient data, offers in the present time no practical or theoretical advantage. The classification of the tetras is highly provisional. It has already been pointed out by several authors (e.g. Fink, 1979) that most of the genera so far included in the Tetragonopterinae, and particularly the large genera like *Hemigrammus* and *Moenkhausia*, are in need of revision using all available methods including phylogenetic analysis. Here we revise the poorly known type species to help in a future revision of the genus.

Without phylogenetic analysis, *Moenkhausia* appears to comprise three morphological groups, with many overlaps:

1) A central group of 25-30 generalized, rather deep-bodied species with a moderate number of transverse scales (5, more rarely 6, from dorsal fin to lateral line);

2) About a dozen small (neotenic?) elongate species, difficult to separate from *Hemigrammus* except by the completeness of the lateral line. In addition to *Moenkhausia phaeonota* Fink, 1979, two species *Moenkhausia pyrophthalma* Costa, 1994 and *Moenkhausia diktyota* Lima & Toledo-Piza, 2001 with an incomplete lateral line have recently been placed in the genus *Moenkhausia*;

3) About a dozen larger species with a deep body and a greater number of transverse scales, grading to the sub-disciform or even disciform body of certain traditionally distinct specialized forms such as *Gymnocyprinus*, *Tetragonopterus*, and the Stethaprioninae.

According to its meristics and proportions, *Moenkhausia heikoi* should be included in the central group (the *M. grandisquamis* group or group b in Géry, 1978), as it has the shared characteristics of a rather deep body (at least in the holotype, which has a body depth of less than 2.66 in SL (or more than 38% of SL) and relatively few transverse scales (5, more rarely 6/3-4). This group includes the type species. The recently-described *Moenkhausia tergimacula* Lucena & Lucena, 1999, from the upper Rio Tocantins (a species close to *M. megalops*), should probably be added to this group.

*Moenkhausia heikoi* can be distinguished from the other species of this group by its different colour pattern, none having a broad longitudinal band. If the colour pattern is discounted, the new species falls between those with a very large eye and those with a "normal" eye (usually more than 2.6 in head length), but is clearly closer to the former.

**Fig. 9.** Another typical *Moenkhausia heikoi* n. sp. habitat in the Rio Iriri where adult specimens were collected deep in the current. Photo by N. Khardina.
Moenkhausia heikoi n.sp., a new tetra from the Rio Xingú basin, Brazil, with a supplementary description of the genus type species

A morphometric comparison can be made using the indented key below (see re-description of M. xinguensis), which replaces those in Eigenmann 1917 and Géry 1978, the only available ones, now obsolete, and summarises the differential diagnosis. This type of key has been chosen to facilitate comparisons with the preceding ones and to facilitate future additions of taxa, but also because, in our opinion, it reflects better (although imperfectly) the putative phylogeny.

The probable affinities of Moenkhausia heikoi n. sp. are to be sought in a few species which, owing to their relatively elongate body, may belong to another group. These are Moenkhausia takasei Géry, 1954 (spelt takesi by Fink 1979) from the Rio Guama close to Belém do Pará, Moenkhausia phaeonota Fink, 1979 from the upper Rio Tapajós, Rio Madeira, and upper Rio Xingú basins, and Moenkhausia lopesi Britski & Silimon, 2001 from the Rio Cuiabá (upper Rio Paraguay basin). Along with several other tetras (e.g. Hypheosobrycon herbertaxelrodi, peruvians, metae and loretoensis, Hemigrammus aguha (pointed out by Fink, 1979), Inpaichthys kerri, Nematoberycon palmeri, Tucanoichthys tucano, and certain Glaudulocaudinae), these species share a specific pattern. This consists of a broad, dark longitudinal band covering at least part of the lower half of the body and usually surmounted by a narrow silvery band. This is also the basic pattern of the neon tetras, except that the band, incomplete in two cases out of the three, is bright red instead of dark or black.

Moenkhausia heikoi differs from the above species in having a somewhat larger and clearly deeper body, a deeper head, a larger eye (except vs. M. lopesi), a longer anal fin, and different coloration: 1 – in Moenkhausia takasei! the black band is restricted to the region above the anal, the upper caudal lobe is yellowish and the eye white.

2 – Moenkhausia lopesi, from a very different river basin, is said to have a different colour pattern with a narrower band, a colourless eye, and orange-yellow unpaired fins. Furthermore, it has one more transverse scale on average; its rather large eye suggests a similar ecology to that of Moenkhausia heikoi.

3 – Moenkhausia phaeonota seems to be the closest form, but photographs of the two forms (Figs. on p. 596 (lower) and p.597, Géry 1978) reveal differences. Moenkhausia heikoi is stout, owing to a putative allometry of the anterior part of the body and the much more anteriorly positioned dorsal fin, whereas M. phaeonota is more fusiform. In Moenkhausia heikoi the band is much broader, chiefly on the anterior part of the body, and higher, while in M. phaeonota it is clearly beneath the midline, so that the light, non-reflective area on the upper half of the flanks is broader. In Moenkhausia heikoi the head is darker, and the striking golden-red iridescence of the upper part of the large eye contrasts with the jet-black part of the head (possibly in connection with the deep, dark biotope). In M. phaeonota the head pattern is more generalized, with dark areas only on the jaws and opercle, and the eye is small and yellowish without the iridescent marking. In the photographs, the fins, apparently quite variable in coloration, appear much paler in Moenkhausia heikoi than in M. phaeonota. In some individual males of the latter, the caudal lobes (chiefly the lower), the anal, the pelvics, and to a lesser extent the dorsal, are dark orange.

These two species, M. heikoi and M. phaeonota, would constitute the sister-species much sought by Fink (1979), were it not that M. phaeonota has an irregular lateral line, usually with the last pores absent in most individuals of several populations, even in the type series, although this character is apparently not mentioned in the first description (Fink 1979). This was ascertained during study of the specimens by the senior author before they were described (see Baensch & Riehl, 1985 p. 290). Note that M. phaeonota occurs not only in the upper Rio Arinos, but also in the upper Rio Aripuana (near the Dardanelos falls) where more than 600 specimens were collected; these were subsequently identified by the senior author, and in the upper Rio Suia Missu, a southern tributary of the Rio Xingú, the two species being separated by innumerable rapids and waterfalls. The morphometric differences are summarised in Table I.

Habitat of Moenkhausia heikoi (based on notes by the collector).

Moenkhausia heikoi was found in swift current between large rocks (Figs. 8-9, and backcover). The water was crystal clear and no organic matter was detected. Habitat parameters (26.07.02 at 15:30 hours): pH 7.17; temperature 29.5°C; conductivity 20 µS/cm. The fishes were found between the rocks at depths of from 1.5 to 2.5 metres, sometimes even deeper, in groups of 10-25. The adults (up to 70 mm TL or more) were often accompanied by semi-adults. They generally oriented themselves upstream against the current in places among the rocks that are virtually inaccessible to predators. Because of their concealed habitat and general inaccessibility, they are never caught by local commercial fishermen – in fact commercial fishermen are quite rare. The Rio Iriri can be accessed by boat and only with great difficulty. Apparently no studies of this locality had ever been made. Despite the river being very large and rich in fish, this region is mostly uninhabited. The river bottom is mostly rocks and gravel, with rare sandy areas. Large rocks throughout its length make navigation very dangerous – often impossible.

Biology

According to the collector, fish are rarely found in pairs; the species possibly mate in groups in the highly-oxygenated water of rapids. Most of the fertilized eggs would then be carried away by the current. This hypothesis, which needs to be supported by fur-
ther observations, would explain why very young specimens are found downstream, mostly among underwater roots, and not between rocks, or not upstream from the Rio Iriri. This mode of reproduction in the current would also explain why, despite many observed spawnings, the eggs have never been fertilised in the aquarium.

Provisional list of associated characiform fishes observed in the Rio Iriri
(for the syntopic species see Figs. 10-22)

_Brycon brevicauda_ (Günther, 1864)
_Brycon_ sp.
_Brycon cf. pesu_ Müller & Troschel, 1844, syntopic (Fig. 12)
_Brycon aff. pesu_ (new) (Figs. 10A+11)
_Chalteus_ sp.
_Triportheus aff. rotundatus_ (new), syntopic (Figs.10 A+B)
_Knodus aff. breviceps_ (new)
_Astyanax (Jupiaba) polylepis_ (Günther, 1864)
_Moenkhausia loweae_ Géry, 1992 (geographical form?)
_Moenkhausia cf. copei_ (Steindachner,1882)
_Moenkhausia aff. gracilima_ A (possibly new)
_Moenkhausia aff. gracilima_ B (possibly new)
_Moenkhausia aff. melogramma_ (possibly new)
_Moenkhausia cotinho_ Eigenmann, 1908
_Moenkhausia oligolepis_ (Günther, 1864)
_Moenkhausia xingens_ (Steindachner, 1883)
_Hemigrammus cf. microstomus_ Durbin in Eigenmann, 1918
_Iguanodectes spilurus_ (Günther, 1864)
_Poptella brevispinna_ Reis, 1989
_Acestrorhynchus microlepis_ (Schomburgk,1841)
_Tometes_ sp. (Myliine A), syntopic (Figs. 17)
_Myleus_ sp. (Myliine B), syntopic (Fig. 18)
_Myleus_ sp. (Myliine C), syntopic (Fig. 19 and 21)
_Myleus_ sp. (Myliine D), “torquatus group” (Fig. 20)
_Myleus cf. rubripinnis_ (Müller & Troschel, 1844) ? (not preserved)
_Myleus cf. schomburgkii_ (Jardine in Schomburgk, 1841) (Fig. 22)
_Serrasalmus cf. rhombeus_ (Linnaeus, 1766)
_Serrasalmus cf. humeralis_ Valenciennes, 1849
_Characidium_ sp.
_Leporinus aff. fasciatus_ (new), syntopic (Fig. 13)
_Leporinus aff. megalops_ (possibly new), syntopic (Fig. 14)
_Leporinus aff. maculates_ (new), syntopic (a possible sibling species is under study) (Fig. 15)
_Laemolyta petiti_ Géry, 1964, syntopic (Fig. 16)
_Anostomus intermedius_ Winterbottom, 1980
_Hemiodopsis_ sp.
_Hemiodopsis aff. argenteus_ (new)
_Bivibranchia_ sp.
Moenkhausia heikoi n.sp., a new tetra from the Rio Xingú basin, Brazil, with a supplementary description of the genus type species.
Jacques Géry and Axel Zarske

Fig. 17. *Tometes* sp. (Myleinae A) semi-adult. Caboclo name: *curupite*. (Insert: teeth). Photo by H. Bleher.

Fig. 18. *Myleus* sp. (Myleinae B) adult female. Caboclo name: *caranha*. (Insert: teeth). Photo by H. Bleher.

Fig. 19. *Myleus* sp. (Myleinae C) semi-adult, from near mouth of Rio Iriri. Caboclo name: *pacu manteiga*. Photo by H. Bleher.

Fig. 20. *Myleus* sp. (Myleinae D) "torquatus group", adult. Caboclo name: *pacu branco*. (Insert: predorsal hook (top) and teeth (lower)). Photo by H. Bleher.

Fig. 21. *Myleus* sp. (Myleinae C), juvenile of *pacu manteiga*. Photo by H. Bleher.

Fig. 22. *Myleus cf. schomburgki*, semi-adult. Caboclo name: *pacu cadete*. (Insert: young). Photo by H. Bleher.
Supplementary description of the type species of the genus Moenkhausia Eigenmann

It is regrettable that Eigenmann (1903) selected an obscure form as type species for one of the most important genera of the Characidae. For more than a century, this genus was known only from a single specimen without an exact type locality (“Rio Xingu”) and very possibly restricted to the basin (note that Hemigrammus and Hyphessobrycon are also represented by “atypical” forms). Fortunately recent collections made in the middle Rio Xingu and its tributary the Rio Iriri (the type locality of M. heiko) include a few specimens which are unquestionably M. xinguensis (based on comparison with the holotype of the species).

Moenkhausia xinguensis (Steindachner, 1883) (Figs. 23-28)

Holotype: NMW 57826, 38.9 mm SL, “Rio Xingu, 1874”.
1 ex., MTD F no. 27910, 47.0 mm SL; and 1 ex., pers. coll. J. Géry no. 1063.1.2003, 45.15 mm SL, Rio Iriri into Rio Xingu, St.11: Igarapé Pebo, left bank about 10 km above St.10 (type locality of M. heiko), collected by H. Bleher & N. Khordina July, 2002, with a seine (9 m x 3 m).
1 ex., pers. coll. J. Géry no. 1063.2.2003, 34.45 mm SL, collected by H. Bleher with dipnet (80 cm x 80 cm), October 1999, Rio Xingü St. 4, Igarapé Baliza near mouth.

Description of the holotype (Fig. 25) and description of the 3 recently collected specimens, 34.5-47.0 mm SL (see Table II for proportions as percentages of SL and head length) in the parentheses.

A typical tetra resembling a slightly more elongate Moenkhausia grandisquamis, of moderate size (the same as for M. heiko); body oval, moderately elevated, compressed, not tapering posteriorly, greatest depth in front of dorsal fin 2.35 (2.35 in the largest; 2.70 in the smallest specimen) in SL, suggesting, as in M. heiko, a positive allometry for the body depth (because of few specimens, it is a fragile hypothesis); dorsal fin anterior to or at level of first dorsal ray; prepelvic area flat, angles rounded; all fins not very elongate, without filaments, pectorals and pelvics not reaching or just reaching next respective fin; anterior anal fin rays much longer than posterior, border concave, not forming distinct anterior lobe; adipose fin of moderate size, as in M. grandisquamis for example; caudal peduncle as deep as long or slightly longer in smallest specimen, its depth 8.30 (8.60-9.45) in SL; caudal with lobes slightly damaged, probably pointed, scaled usually to proximal half of lobes, small scales not deciduous.

Head triangular in profile, its length (without membrane) 3.55 (3.10-3.70) in SL; bony interorbital 2.90 (2.55-2.65), two largest specimens, to 3.47) in head length; eye large ca. 2.50 (2.40-2.45) in head length; maxilla rather narrow, reaching level of pupil in largest specimen, 2.75 (2.90-3.20) in head length; snout moderate but short in comparison to large eye, rather square, ca. 4.50 (3.95 to 4.95) in head length (in projection), protruding slightly over lower jaw (whereas in holotype anterior profile of head is slightly oblique with snout behind lower jaw); mouth terminal; fontannel long, extending from slightly behind level of anterior margin of pupil to supracoecipital; 6 circumorbitals, but S06 reduced to its canal; S03 developed in largest specimen, touching subopercular canal in its vertical portion, but not at angle and on its horizontal part, where it leaves a large so-called “naked” triangle; in holotype, S03 not touching subopercular canal all around.

Scales cycloid, with a few slightly diverging radii, not curved up and down as in Moenkhausia grandisquamis; lateral line complete, slightly curved; 33 (32-34) pored scales; 10 transverse scales from dorsal to pelvic, formula 5/4 (5/4); 9 (7.1/2 or 8) predorsal scales in a regular series, 12? (12-13 (14?)) around caudal peduncle; dorsal fin with 2 anterior unbranched rays and 9 (8) branched rays; anal fin originating well behind level of last dorsal ray, with 3 (3 or 4) anterior unbranched rays, and 22i (22-23) branched, without sexual hooklets; anterior part of fin base covered by single row of small scales (two rows in holotype).

Premaxilla with 4 (4-5) tricuspid teeth in somewhat irregular outer row on each side (third tooth slightly displaced posteriorly), and 5 (5) quincuspid teeth in inner row, large and concave anteriorly; maxilla with 0 (2 or 3) teeth at angle; lower jaw with 4 (4) large quincuspid frontal teeth, the fourth posteriorly inclined, followed by about 13 (13) small tricuspid to conical teeth; gill rakers 9/12 (9/13) on first arch, lower ones rather long and thin; opercle with distinct notch on upper-posterior margin, situated somewhat lower than in M. heiko.

Coloration in preservative: a broad lead-coloured band, one and a half scales wide, extending from slightly before dorsal level to the end of the caudal peduncle, not prolonged onto the caudal rays, somewhat oblique, starting above the lateral line and body axis (i.e. midline, from mouth to middle of caudal) and ending on the axis of the peduncle; this corresponds to the silvery band described by Steindachner. The longitudinal band is preceded by a dark humeral spot, irregularly triangular with a roundish ventral extension separated from it by a light line, well above the 3rd to 6th scale of the lateral line. No visible black line on the anal fin base; no other visible colour pattern; fins apparently hyaline. The holotype has no visible colour pattern apart from a silvery band along the great axis.
Jacques Géry and Axel Zarske

Fig. 23. *Moenkhausia xinguensis*, 47.0 mm SL, topotypical ex., MTD F 27910, fixed in formalin. Photo by F. Höhler.

Fig. 24. *Moenkhausia xinguensis*, alive, before fixation, topotypical ex., MTD F 27910. Photo by H. Bleher.

Fig. 25. *Moenkhausia xinguensis*, 38.9 mm SL, holotype NMW 57826, probably it was fixed in alcohol. Photo courtesy of NMW.

Fig. 26. *Moenkhausia xinguensis*, alive, before fixation, 45.15 mm SL, coll. at Rio Iriti into Rio Xingú, St.11: Igarapé Pebo. Photo by H. Bleher.

Fig. 27. Radiograph of *Moenkhausia xinguensis*, topotypical ex., MTD F 27910. Photo by Axel Zarske.

Fig. 28. *Moenkhausia xinguensis*, alive before fixation, 34.45 mm SL, coll. October 1999, Rio Xingú St. 4, Igarapé Baliza near mouth. Photo by H. Bleher.
of the body (there was a "large humeral spot" at the time of the original description).

**Coloration in life:** a according to photographs taken on the spot (Figs. 24, 26 and 26), colours rather dull, humeral spot Blackish and band bluish or silver, upper part of eye pale golden.

**Discussion**

These recently collected specimens of *M. xinguensis* agree with the morphometrics of the holotype, except in a slightly broader interorbital, slightly more posterior lower jaw and the presence of maxillary teeth, whereas the maxilla of the holotype seems toothless (no dissection could be made). This seems insufficient, or least provisionally, to recognize two forms.

On this assumption, an extended definition of the type species of *Moenkhausia* is to be provided. In particular that the eye is large, up to 2.35 in head length, and the maxilla toothed, at least in some specimens, with up to 3 small teeth at angle. Its large eye suggests proximity to *M. megalops*, a rare species from the nearby Rio Tapajós (and Guyana). But the two species are apparently distinct, *M. megalops* having, more anal rays, more scales, and a different colour pattern.

The phenotypic similarities between the two just described species and the other members of the artificial group (depth usually less than 2.66 in SL in adults; transverse scales usually 5/3-4, with few exceptions: 6 above lateral line in *M. inrai*, *M. georgiae*, *M. robertsi*, and *M. melogramma*) can be distinguished from each other with the key presented below.

**Tentative identification key to adults of the Moenkhausia xinguensis group**

1a. Caudal pattern as in *M. lepidura* group, i.e. with upper caudal lobe, sometimes also lower lobe and median rays, marked with a “flag” (depth 2.2-2.8 in SL; lateral line scales 31-36; anal rays iii-iv, 22-27)

2a. Usually only upper lobe marked

3a. Black caudal marking not extending obliquely onto peduncle to anal base

4a. Transverse scales 5 above lateral line (depth 2.35-2.7 in SL)

5a. 3-3.1/2 scales from lateral line to pelvic fin; median caudal rays hyaline; anal rays iii, 20-25; lateral line scales 31-34)

6a. Anal rays iii,22-25; lower jaw slightly displaced posteriorly

...*Moenkhausia lata* Eigenmann, 1908, Amazon basin; type locality Rio Tapajós

6b. Anal rays iii,20-22; lower jaw slightly anterior to upper jaw level

...*Moenkhausia cf. lata* (sensu Géry, 1992), Rio das Mortes and Oiapock

5b. 4-4.1/2 scales from lateral line to pelvic fin; median caudal rays dark (Anal rays iii,26-27; lateral line scales 34-36)

...*Moenkhausia aff. lata* (sensu Géry, 1992), Rio Curua Una

4b. Transverse scales 6 above lateral line (depth 2.2-2.8; anal rays iii-iv,24-25; scales 6/34-35/4-4.1/2; median caudal rays hyaline; external premaxillary teeth 3-6; maxillary teeth 2-4)

...*Moenkhausia inrai* Géry, 1992, French Guiana

3b. Black caudal marking extending obliquely onto peduncle to anal base (27-28 anal rays; 32-33 lateral line scales

...*Moenkhausia costae* (Steindachner,1907), Rio Sào Francisco and Rio Itapicuru

2b. Both lobes usually marked, as in *Moenkhausia dichroura* (28-31 anal rays; two quite similar species, not yet revised, perhaps belonging to a hypothetical *dichroura* group)

7a. Body depth 2.6 in SL; 35 lateral line scales

...*Moenkhausia ortegusae* Fowler,1943, Colombia

7b. Body depth 2.4 in SL; 37 lateral line scales

...*Moenkhausia barbouri* Eigenmann, 1908, Amazon basin

1b. Caudal pattern not as in *M. lepidura* or *dichroura* group, caudal lobes usually hyaline

8a. Eye moderate, its diameter 2.5 or more in head length (in adults)

9a. Anal lobe black or with an oblique line (no caudal spot)

10a. No dorsal spot; body depth 2.0-2.33 in SL; about 38 lateral line scales; 33-34 anal rays

...*Moenkhausia affinis* Steindachner, 1915, lower Rio Negro

10b. Dorsal spot (present on the anterior fins rays); body depth 2.45-2.75 in SL; 31-33 lateral line scales; 23-28 anal rays

...*Moenkhausia hemigrammoides* Géry, 1966, Guianas (strongly resembling *Hemigrammus unilin- eatus*, and of uncertain systematic position)

9b. Anal lobe usually plain

11a. Body depth about 2.0-2.2 in SL (26-32 anal rays; 31-34 lateral line scales

12a. Longitudinal stripes through centre of scales; 30-32 anal rays (humeral and caudal spots rather indistinct)

...*Moenkhausia simulata* Eigenmann & Pearson, 1929, Rio Pachitea, upper Amazon basin

12b. No longitudinal stripes through centre of scales; 26-30 anal rays

6a. Conspicuous black caudal spot (radii of scales not diverging up and down)

14a. Scales 5/31/4

...*Moenkhausia ovalis* (Günther,1868), Amazon basin...
14b. Scales 6/32-34/4-5 (a species strongly resembling *Tetragonopterus chalceus*)

...*Moenkhausia georgiae* Géry, 1966, Guianas

13b. No caudal spot

15a. Radii of scales diverging up and down (scales 5/31-34/4)

...*Moenkhausia grandisquamis* Müller & Troschel, 1845, Guianas and Amazon basin

15b. Radii of scales not diverging up and down, but “fan-like” as in other spp. of genus (scales 5/31-34/4)

...*Moenkhausia aff. grandisquamis* sensu Géry et al., 1991, French Guiana

11b. Body depth usually 2.2-2.66 in SL, at least in adults

16a. Conspicuous black caudal spot (5 or 6 scales above lateral line)

17a. Broad black bar across entire caudal peduncle; body depth 2.20-2.25 in SL on average; 22-32 lateral line scales; see also *M. cotinho*, more elongate, of a different group?

16a. 29-32 lateral line scales

...*Moenkhausia oligolepis* (Günther,1864), Guianas and Amazon basin

18b. 22-26 longitudinal scales (lateral line often irregular or incomplete)

...*Moenkhausia sanctaeflomenae* (Steindachner, 1907), south of the Amazon basin, Rios Paraguay and Parnaiba

17b. Caudal spot on middle caudal rays only; body depth 2.60 in SL on average; 34-36 lateral line scales

...*Moenkhausia robertsi* Géry 1964, Iquitos, upper Amazon

16b. No caudal spot (5 scales above lateral line except 6 in *M. melogramma*)

19a. Black line along anal base, as in *M. copei* and *M. colletti* for example (about 34 lateral line scales and 26 anal rays)

...*Moenkhausia melogramma* Eigenmann,1908, Amazon basin (probably more than one form)

19b. No black line along anal base

20a. 30-32 lateral line scales; 23-24 anal rays

...*Moenkhausia browni* Eigenmann,1909, Guyana

20b. 33-37 lateral line scales; 26-29 anal rays

...*Moenkhausia agnesae* Géry 1965, Rio Solimões

8b. Eye large, its diameter 1.8-2.4 in head length in adults (34-37 lateral line scales)

21a. No very broad longitudinal band

22a. No caudal spot; vertical humeral spot (26-30 anal rays)

23a. Body depth 2.50-2.66 in SL; no saddle-like black blotch anterior to first dorsal ray

24a. Anal iii,iv; 22-23; 32-34 lateral line scales; eye usually more than 2.30 in head length; lead-coloured longitudinal band

...*Moenkhausia xinguensis* (Steindachner 1882), endemic to Rio Xingu basin, type of genus

24b. Anal iii,iv; 26-27; 35-36 lateral line scales; eye 2.10-2.30 in head length; no lead-coloured longitudinal band

...*Moenkhausia megalops* (Eigenmann,1907), Amazon basin and Guyana

23b. Body depth 2.0-2.3 in SL; saddle-like black blotch anterior to first dorsal ray

...*Moenkhausia tergimacula* Lucena & Lucena,1999, upper Rio Tocantins at Serra da Mesa dam

22b. Small caudal spot; no humeral spot; 26 anal rays (see also *M. georgiae*)

...*Moenkhausia shideleri* Eigenman 1909, Guyana

21b. Very broad longitudinal band (indistinct humeral and caudal spots within band)

...*Moenkhausia heikoi* n. sp., Rio Xingu

References


