Description of a new species of annual fish, *Maratecoara gesmonei* (Cyprinodontiformes: Rivulidae) from the rio Xingu system, Amazon basin, Brazil

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Abstract

Maratecoara gesmonei n. sp., found on a temporary pool at a fluvial island in the middle rio Xingu, Pará State, Brazil, is described herein. This is the first occurrence of this genus in the Rio Xingu drainage, Amazon basin. The new species differs from all congeners by its unique color pattern which lacks horizontal rows of small dark orange spots on the antero-dorsal portion of the flanks (vs. 2-3 on *M. lacortei*, 3 on *M. formosa* and *M. splendida)*, or orange oblique bars on anteroventral portion of trunk (vs. 4-5 orange oblique bars on anteroventral portion of trunk in *M. formosa*, 3-4 in *M. splendida* or a broad blotch in *M. lacortei)*. In addition, the new species can be diagnosed from congeners by its lower body depth (23.7-25.9% SL vs. 30.4-40.0% SL), lower caudal peduncle depth (13.0-15.5% SL vs. 17.1-21.6% SL), and lower number of vertebrae, 25-26 (vs. 27-28 in *M. lacortei*, 26-27 in *M. formosa*, and 27 in *M. splendida)*.

Resumo

Maratecoara gesmonei n. sp., encontrada em uma poça temporária em uma ilha fluvial no médio rio Xingu, estado do Pará, Brasil, é aqui descrita. Esta é a primeira ocorrência do gênero na drenagem do Rio Xingu, bacia Amazônica. A nova espécie difere de todas as congêneres pelo padrão único de cor com ausência de linhas horizontais e pequenas manchas laranjas escuras na porção antero-dorsal dos flancos (vs. 2-3 na *M. lacortei*, 3 em *M. formosa* e *M. splendida)*, ou barras oblíquas laranjas (vs. 4-5 barras oblíquas laranja em *M. formosa*, 3-4 em *M. splendida* ou uma grande mancha em *M. lacortei)*. Adicionalmente, a nova espécie pode ser diagnosticada de suas congêneres pela menor altura do corpo (23.7-25.9% SL vs. 30.4-40.0% SL), menor altura pedúnculo caudal (13.0-15.5% SL vs. 17.1-21.6% SL) e pelo menor número de vértebras, 25-26 (vs. 27-28 em *M. lacortei*, 26-27 em *M. formosa* e 27 em *M. splendida)*.

Zusammenfassung

Beschrieben wird hier *Maratecoara gesmonei* n. sp, deren Vertreter in einem zeitlich begrenzten Tümpel auf einer Flussinsel im mittleren Rio Xingu im Bundesstaat Pará in Brasilien entdeckt wurden. Es handelt sich um den ersten Nachweis dieser Gattung im Einzugsgebiet des Xingu im Amazonasbecken, Brasilien. Die neue Art unterscheidet sich von allen anderen Angehörigen der Gattung durch das unverkennbare Farbmuster: die waagerechten Reihen kleiner, dunkel orangefarbener Flecken im vorderen Rückenbereich der Flanken fehlen hier (im Gegensatz dazu sind bei *M. lacortei* 2-3 Reihen, bei *M. formosa* und *M. splendida* 3 Fleckenreihen vorhanden); auch fehlen hier die orangefarbigen schrägen Streifen im vorderen bauchseitigen Teil des Rumpfes (bei *M. formosa* sind 4-5 schräge orangefarbene Streifen vorhanden, bei *M. splendida* 3-4, bei *M. lacortei* ein breiter Fleck). Weitere Unterscheidungsmerkmale von den anderen Art der Gattung sind: eine geringere Körpertiefe (23,7-25,9 % der Standardlänge SL im Gegensatz zu 30,4-40,0% der SL bei den anderen Arten), eine geringere Schwanzstieltiefe (13,0-15,5% der SL vs. 17,1-21,6% der SL) sowie eine kleinere Wirbelzahl (25-26 im Vergleich zu 27-28 bei *M. lacortei*, 26-27 bei *M. formosa* und 27 bei *M. splendida)*.

Résumé

Maratecoara gesmonei n. sp., trouvé dans une mare temporaire sur une île fluviale du moyen Rio Xingu, état de Pará, Brésil, est décrit ci-après. C'est la première occurrence de ce genre dans le système du Rio Xingu, bassin de l'Amazone. La nouvelle espèce se distingue de tous ses congénères par un patron de coloration unique qui ne comprend pas de rangées horizontales de petites taches orange foncé sur la partie antérodorsale des flancs (contre 2-3 pour *M. lacortei*, 3 pour *M. formosa* et *M. splendida)* ou des barres obliques orange sur la partie antéroventrale du tronc

(contre 4-5 barres obliques orange sur la partie antéroventrale du tronc pour *M. formosa*, 3-4 pour *M. splendida* ou une large tache pour *M. lacortei)*. En outre, la nouvelle espèce peut être séparée de ses congénères par sa plus faible hauteur du corps (23,7-25,9 % de LS vs. 30,4-40,0 de LS), une plus faible hauteur du pédoncule caudal (13,0-15,5 % de LS vs. 17,1-21,6 % de LS) et un nombre inférieur de vertèbres, 25-26 (vs. 27-28 pour *M. lacortei* 26-27 pour *M. formosa* et 27 pour *M. splendida)*.

Sommario

Maratecoara gesmonei n. sp., trovata in una pozza temporanea su un'isola fluviale del medio corso del Rio Xingu, Stato di Parà, Brasile, viene qui descritta. Questa è la prima segnalazione di questo genere nel sistema del Rio Xingu, bacino idrografico amazzonico. La nuova specie si differenzia da tutte le congeneri per la particolare colorazione caratterizzata dall'assenza di righe orizzontali di piccole macchie di colore arancione scuro sulla porzione anterodorsale dei fianchi (vs. 2-3 a *M. lacortei*, 3 su *M. formosa* e *M. splendida)* o barre oblique arancione sulla parte anteroventrale del tronco (vs. 4-5 barre oblique arancione su parte anteroventrale del tronco in *M. formosa* e 3-4 in *M. splendida* o un'estesa macchia in *M. lacortei)*. Inoltre, la nuove specie può essere diagnosticata dalle congeneri per una minore altezza del corpo (23.7-25.9% SL vs. 30.4-40.0% SL), una minore altezza del peduncolo caudale (13.0-15.5% SL vs. il 17.1-21.6% SL) e un minor numero di vertebre, 25-26 (vs. 27-28 in *M. lacortei*, 26-27 in *M. formosa* e 27 in *M. splendida)*.

INTRODUCTION

In the middle of the 1980's, annual fish enthusiasts collected three undescribed species of annual fish from the family Rivulidae in a temporary pool near the city of Aruanã, located on the right bank of the rio Araguaia, Goiás state, Brazil. These three new species were then temporarily identified by the codes GO-1, GO-2, and GO-3. All three species were very beautiful and distinct from what was then known to ichthyologists and aquarists at the time. One of them, GO-3, called a great deal of attention because it possessed a metallic blue coloration and long extensions on the dorsal and anal fins, recalling another species of annual fish, *Terranatos dolichopterus* Weitzman & Wourms, 1967, from the río Orinoco basin in Venezuela. Not until 1991 were these three species finally described as belonging to the genus *Cynolebias* Steindachner, 1876. The species that was initially designated with the code GO-3 was described as *Cynolebias lacortei* (Lazara, 1991).

Costa (1995a) erected a new genus, *Maratecoara*, and the species *Cynolebias lacortei* became the type species of this new genus. In the same work, a second species of *Maratecoara* was described, *Maratecoara formosa* Costa & Brazil, 1995. It originates from the city of Brejinho do Nazaré, Tocantins state, and was found in an annual pool in the left bank of the rio Tocantins. More recently, Costa (2007), described one additional new species, *Maratecoara splendida* Costa, 2007, originating from an annual pool located close to the rio Canabrava, a tributary of the left bank of the rio Tocantins.

The genus *Maratecoara* belongs to the subfamily Rivulinae Myers 1925, tribe Rachoviini Costa, 1990 and the subtribe Plesiolebiina Costa, 1990. Within the subtribe Plesiolebiina, are also included the genera *Plesiolebias* Costa 1989, *Pituna* Costa 1989, *Papiliolebias* Costa 1998, and *Stenolebias* Costa 1995a. So far, the genus *Maratecoara* species is known exclusively from the rio Tocantins/Araguaia basin in central Brazil. The new species described herein is the first found outside this system, at the middle rio Xingu basin, a the right bank tributary of the Amazon River. It is also the first species described from the Amazon forest domain - the other species are found in the savannah-like Cerrado domain.

MATERIAL AND METHODS

Measurements were taken point-to-point under the stereomicroscope with the digital caliper to the nearest 0.01mm, on the left side of the specimen whenever possible, following Costa (1995b, 2007). Measurements are expressed as percentages of standard length (SL), except subunits of the head, which are recorded as percentages of head length (HL).

In the description, counts of vertebrae and pleural ribs were taken from cleared and stained (c&s) specimens, one male and one female paratypes, prepared according to Taylor & Van Dyke (1985). Terminology for frontal squamation follows Hoedeman (1958) and Costa (2006). For vertebral counts the caudal compounded centrum was counted as a single element. Osteological features included in the description are those considered phylogenetically informative by recent studies on Plesiolebiasiina (Costa 2007). Institutional abbreviations are LBP (Laboratório de Biologia e Genética de Peixes, Universidade Estadual Paulista, Botucatu, Brazil), UNITAU (Universidade of Taubaté, Taubaté, Brazil), and ZUEC (Museu de Zoologia da Universidade Estadual de Campinas, Campinas, Brazil). Comparisons with congeners were based primarily on the literature (Costa, 2007).

Maratecoara gesmonei, n. sp.
(Figs 1-2; Table I)

Holotype: ZUEC 7851, male 23.4 mm SL: Brazil, Pará state, São Félix do Xingu, temporary pool at island in the middle of the rio Xingu 06°39'33.3" S 52°00'21.9" W; 17 May 2013, Ricardo Britzke & Mayler Martins.

Paratypes: LBP 18387, four males, 18.5-20.4 mm SL, six females, 17.9-24.5 mm SL, collected with the holotype. ZUEC 7852 (2 c&s), one male 19.6 mm SL and one female 18.8 mm SL, collected with the holotype.

Diagnosis: Males of *Maratecoara gesmonei* differs from the remaining congeners by a lower body depth (23.7-25.9% SL vs. 30.4-40.0% SL); lower caudal peduncle depth (13.0-15.5% SL vs. 17.1-21.6% SL); lower length of dorsal-fin base (13.5-14.5% SL vs. 14.9-19.6% SL); lower length of anal-fin base (19.7-21.5% SL vs. 20.3-27.2% SL); lower caudal-fin length (34.1-41.4% SL vs. 49.2-62.5% SL); lower pelvic-fin length (12.2-14.8%

Fig. 1. *Maratecoara gesmonei*, ZUEC 7851, holotype, male, 23.4 mm SL. Photo by M. Martins.

Fig. 2. *Maratecoara gesmonei*, LBP 18387, paratype, female, 24.5 mm SL. Photo by M. Martins.

Table I. Morphometric and meristic data for the holotype (H) and paratypes of *Maratecoara gesmonei*. SD = Standard deviation.

	H	Paratypes		Mean±SD
	Male	Male n=5	Females n=7	
Standard length (mm)	23.4	18.5-20.4	17.9-24.5	19.4±1.53
Percents of SL				
Body depth	25.9	23.7-25.9	23.9-25.9	24.9±0.87
Caudal peduncle depth	15.5	13.0-15.5	12.7-12.9	13.8±1.26
Pre-dorsal length	66.8	63.2-67.8	60.1-66.8	65.9±1.82
Pre-pelvic length	51.8	49.5-51.8	52.8-53.2	52.1±1.12
Length of dorsal-fin base	14.5	13.5-14.5	11.3-13.3	13.2±1.17
Length of anal-fin base	19.7	19.7-21.5	15.9-18.1	18.4±2.05
Caudal-fin length	41.4	34.1-41.4	31.9-37.2	36.0±3.17
Pectoral-fin length	23.3	23.3-27.2	19.1-23.8	23.7±2.27
Pelvic-fin length	14.8	12.2-14.8	12.7-14.9	13.5±1.02
Head length	37.3	34.6-37.7	33.6-36.2	35.5±1.47
Percents of HL				
Head depth	62.5	62.5-64.6	63.0-64.7	06.7±0.83
Head width	34.7	33.8-35.7	35.3-39.7	63.4±2.37
Lower jaw length	13.8	13.8-15.4	12.8-14.4	14.3±0.67
Eye diameter	31.9	30.8-34.3	30.8-33.3	32.0±1.10
Counts				
Dorsal fin	11	11	10	
Caudal fin	24	25	24	
Anal fin	14	14-15	14	
Pelvic fin	7	7	7	
Pectoral fin	13	13	13	
Meristic				
Scales in longitudinal series		25-26	25	
Scales in transversal series		8	8	
Horizontal scales around caudal peduncle		16	16	

SL vs. 15.0-20.0% SL); lower head depth (62.5-64.6% HL vs. 92.2-112.4% HL); lower head width (33.8-35.7% HL vs. 54.9-65.8% HL); pectoral-fin posterior margin reaching vertical between base of the 1st and 2nd anal-fin rays (vs. 5thand 7th in *M. lacortei*, 4th and 5th in *M. formosa*, and 4th and 6th in *M. splendida);* contact organs absent (vs. 3-5 on posterior margin of each scale on ventral portion of flanks in males in *M. lacortei*, *M. formosa*, and *M. splendida);* anal-fin origin between pleural ribs of 12th and 13th vertebrae (vs.10th and 11th in *M. lacortei* and *M. formosa*, 10th and 12th in *M. splendida);* lower number of caudal-fin rays, 24-25 (vs. 27-30 in *M. lacortei*, 25-26 *M. formosa*, and 25-27 *M. splendida);* lower number of pelvic-fin rays, 7 (vs. 8 in *M. lacortei*, *M. formosa*, and *M. splendida);* lower number of transverse series of scales, 8 (vs. 9-10 in *M. lacortei*, 9 in *M. formosa*, and *M. splendida);* lower number vertebrae, 25-26 (vs. 27-28 in *M. lacortei*, 26-27 *M. formosa*, and 27 in *M. splendida).* Additionally, males of *Maratecoara gesmonei* differs from males of the remaining species of the genus *Maratecoara* by presenting a body color pattern without horizontal rows of small dark orange spots on the antero-dorsal portion of flanks (vs. 2-3 in *M. lacortei*, 3 in *M. formosa* and *M. splendida),* by lacking orange oblique bars on anteroventral portion of trunk (vs. 4-5 orange oblique bars on anteroventral portion of trunk in *M. formosa*, and 3-4 in *M. splendida*, and a broad blotch in *M. lacortei),* and by presenting overall body coloration with irregular stains of orange and metallic blue (vs. overall body coloration metallic blue with horizontal orange spots in *M. lacortei*, metallic blue with horizontal and oblique orange spots in *M. formosa* and *M. splendida).*

Females of *Maratecoara gesmonei* differ from females of remaining species of the genus *Maratecoara* by presenting a lower body depth (23.9-25.9% SL vs. 28.2-34.3% SL); lower caudal peduncle depth (12.7-12.9% SL vs. 15.1-18.4% SL); lower length of dorsal-fin base (11.3-13.3% SL vs. 13.6-16.5% SL); lower length of anal-fin base (15.9-18.1% SL vs. 19.3-22.2% SL); lower caudal-

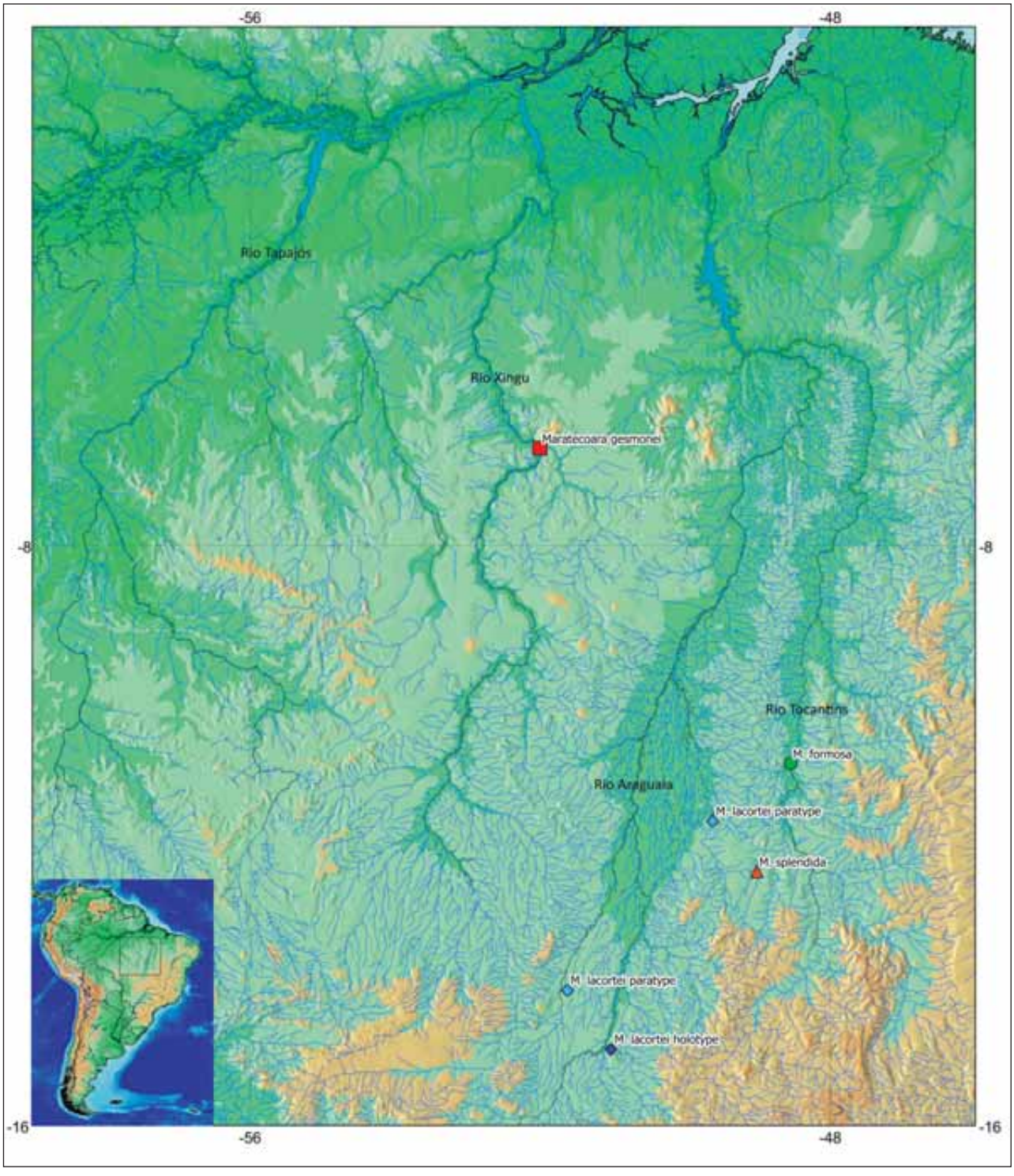

Fig. 3. Geographic distribution of the species of the genus *Maratecoara*.

fin length (31.9-37.2% SL vs. 39.6-43.2% SL); lower pectoral-fin length (19.1-23.8% SL vs.24.5-29.7% SL); lower head depth (63.0-64.7% HL vs. 78.1-90.1% HL); lower head width (35.3-39.7% HL vs. 53.3-61.5% HL); and lower eye diameter (30.8-33.0% HL vs. 34.4-37.9% HL).

Description: Morphometric data presented in Table I. Largest male examined 23.4 mm SL, largest female examined 24.5 mm SL. Dorsal profile slightly concave between head and base of dorsal-fin, slightly convex at caudal peduncle. Ventral profile gently convex from lower jaw to end of anal-fin base and nearly straight from latter point to caudal peduncle. Body moderately slender, greatest body depth at level of pelvic-fin base. Jaws short, prognathous, snout slightly pointed. Dorsal fin elongated in males, pointed, rays 7-8 much more elongated than remaining rays, filamentous, tips reaching at least distal margin of caudal fin when adpressed to the body; anal fin pointed in males, pointed, rays 7-8 much more elongated than remaining rays, filamentous, tips reaching distal margin of caudal fin when adpressed to body; dorsal and anal fins just slightly pointed in females. Caudal-fin lanceolate in males, middle caudal-fin rays filamentous, caudal-fin rounded in females. Pectoral-fin elliptical, distal margin reaching vertical between base of 1st and 2nd anal-fin rays in males, between urogenital papilla and anal-fin origin in females. Pelvic-fin elliptical, without filaments; tip of each pelvic fin reaching between base of 3rd and 4th anal-fin rays in males, reaching to between base of 1st and 2nd anal-fin rays in females. Pelvic-fin bases in close proximity medially. Dorsal fin origin on vertical between base of 3rd and 5th anal-fin rays, and between neural spines of 11th and 12th vertebrae in males and 13th and 14^{tth} in females. Anal fin origin between pleural ribs of 12th and 13th vertebrae. Dorsal-fin rays 10-11; anal-fin rays 14-15; caudal-fin rays 24-25; pectoral-fin rays 13; pelvic-fin rays 7.

Scales cycloid: No scales on caudal, dorsal and anal-fins bases. Frontal squamation F-patterned; E-scales not overlapping medially; scales arranged in regular transverse pattern. Longitudinal series of scales 25-26; transverse series of scales 8; scale rows around caudal-fin peduncle 16. Contact organs absent.

Fig. 4. Type locality of *Maratecoara gesmonei*, pool at island at the middle of the Rio Xingu, in front of São Félix does Xingu, Pará, Brazil. Photo by M. Martins.

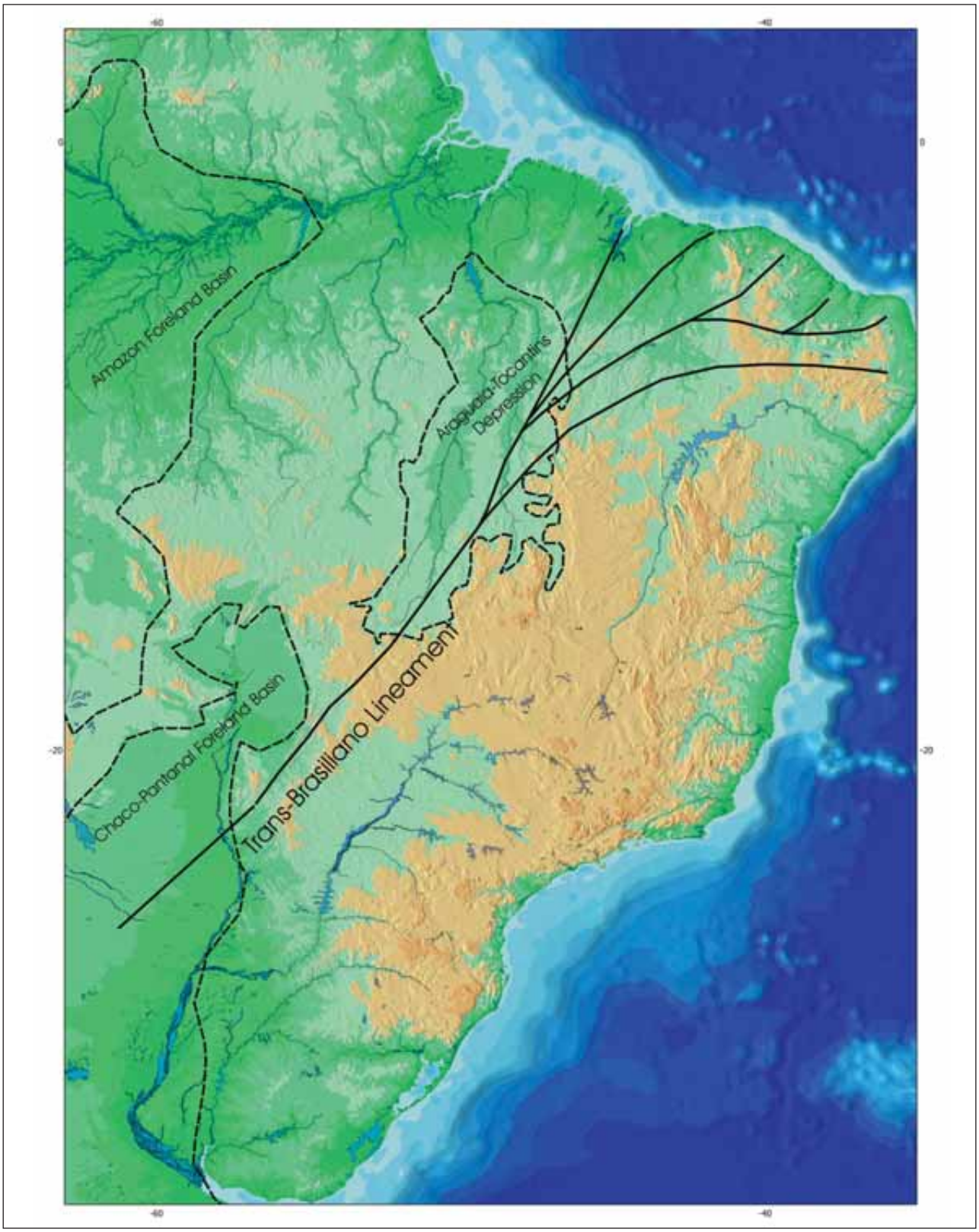

Fig. 5. Physical map of eastern South America, showing the Araguaia-Tocantins depression and the Transbrasiliano Lineament.

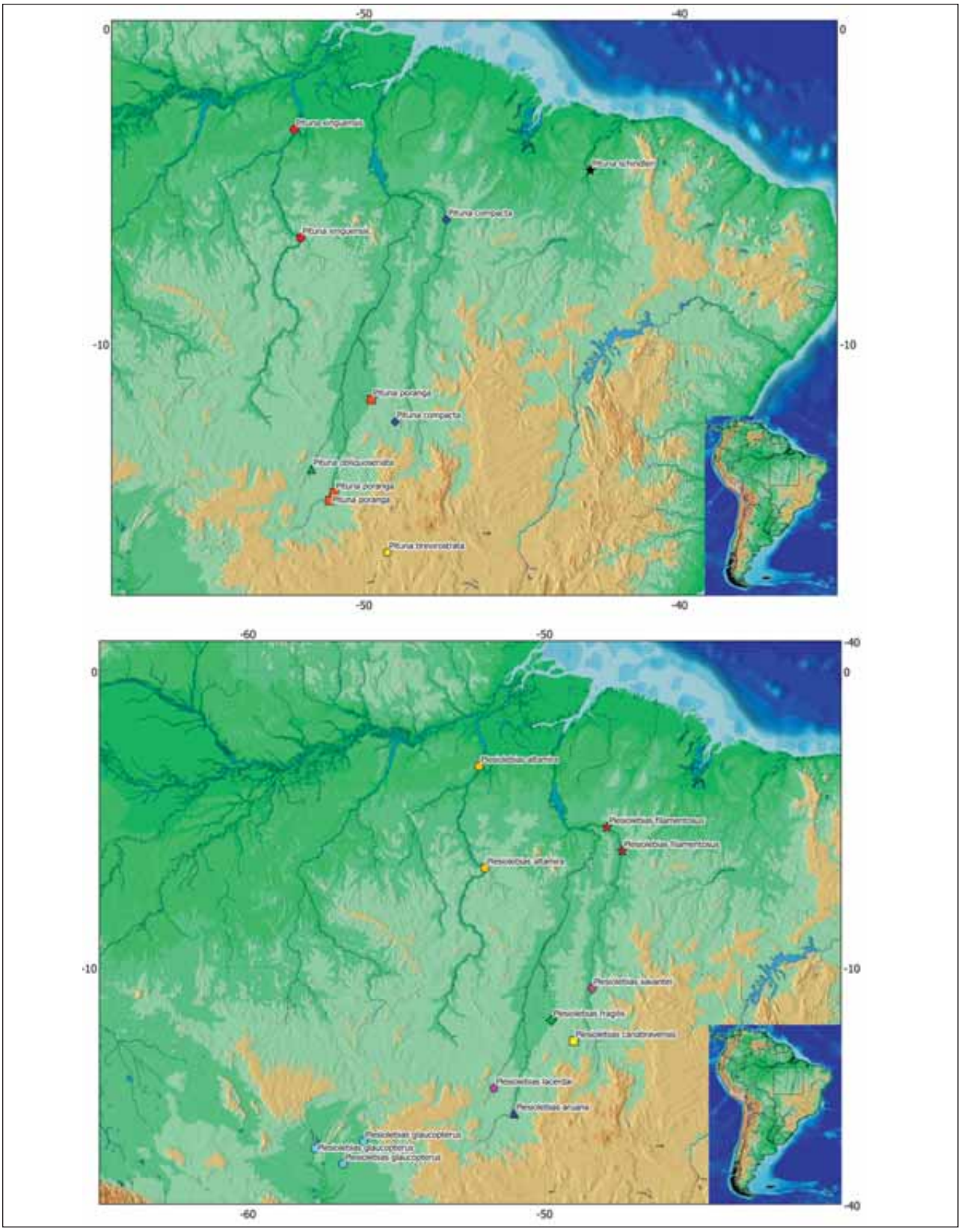

Fig. 6. Geographic distribution of the genera *Pituna* and *Plesiolebias*.

Cephalic neuromasts: supraorbital 6+3, parietal 3, anterior rostral 1, posterior rostral 1, infraorbital 1 + 25, preorbital 4, otic 1, post-otic 2, supratemporal 1, median opercular 1, ventral opercular 1, preopercular 14, mandibular 8, lateral mandibular 5.Two neuromasts on fin base. Total vertebrae 25-26.

Coloration in life (Figs 1-2). Males: Sides of body metallic blue and orange with irregular color distribution, without bars or lines, dorsally orange. Abdominal region clear. Sides of head metallic blue and orange. Jaws orange. Iris bright green; a black bar vertically crossing the eye. Dorsal-fin orange with metallic blue blotches. Anal-fin metallic blue with slightly orange stains. Caudal-fin orange with metallic blue spots. Pectoral-fins hyaline. Pelvic-fins metallic blue with an orange spot.

Females: Overall color light brownish gray, with longitudinal rows of pale brown dots on the sides of body. Abdominal region clear. Sides of head and jaws gray, with a pale greenish yellow hue. Iris yellow, with a dark gray vertical bar through center of eye. Fins hyaline.

Distribution: Currently only known from the type-locality, a temporary pool at an island from middle rio Xingu, Amazon basin, Pará state, Brazil (Fig. 3).

Habitat (Fig. 4): The type-locality lies in a plateau area of Brazil (198 m *a.s.l.)*, on an island in the middle of the rio Xingu, in front of the city of São Félix do Xingu. The island has a total area of about 465m^2 and a perimeter of about 3.160 km.It lies about 330 m from the left bank of the river and about 540 m from the right bank. The annual pool is very large with most of its area within a dense forest. Water temperature, at the depth of 25 cm was 26.5°C, whereas at the marginal area of the pool, at the depth of 5 cm, was 27.5°C. The average depth of the pool was 0.5 m, with the deepest portions about 1.20 m. Water color was dark and acidic, with pH 5.5. Other physic-chemical parameters were: electric conductibility 8 μS, total hardness (GH) 0°dGH, carbonate hardness (KH) 0°dGH, dissolved iron (Fe) 0.5 mg/l, dissolved calcium (Ca) 0 mg/l, dissolved copper (Cu) 0 mg/l, dissolved phosphate (PO_4) 0.1 mg/l, and ammonium/ammonia (NH_3/NH_4) 0 mg/l.

Other annual fish species collected syntopically were *Pituna xinguensis* and *Plesiolebias altamira*. The pool was beginning to dry up and the collectors also found juveniles of the following characiform fish species living syntopically: *Moenkhausia xinguensis*, *M. ceros*, *Jupiaba* sp., *Hyphessobrycon* sp., *Thayeria boehlkei; Serrassalmus* sp., and *Hoplias malabaricus*. Other aquatic animals recorded at the site were tadpoles and freshwater crabs. Aquatic vegetation was not present and the bottom was composed of clay, leaves, sand and mud. *Maratecoara gesmonei* was always found in areas close the margin of the pool, nearby submerged trunks, at about 50 cm depth, while *Pituna xinguensis* was found in more shallow areas (about 5 cm deep) and *Plesiolebias altamira* in deeper areas (about 1 meter deep).

Etymology: The specific name *gesmonei* is treated as a patronym in gratitude and recognition to Gesmone Fernandes Godoy, who discovered the species.

DISCUSSION

The genus *Maratecoara* is defined by the following synapomorphies: long dorsal and anal fins with tips extending beyond the posterior margin of caudal-fin; caudal-fin lanceolate, tip with two or three filamentous rays; long opercular membranes with blue iridescence, extending on to the anterior portion of pectoral-fin; and flanks metallic blue with orangish golden spots (Costa, 2007).

The discovery of annual pools in São Félix do Xingu increases the knowledge of distribution of annual fishes in the rio Xingu basin, which were so far only known to the neighborhoods of Altamira, where the Belo Monte dam is currently being build. The building of this dam will probably destroy the known habitat of the annual fishes that were so far known from the rio Xingu basin, *i.e.*, *Spectrolebias reticulatus*, *Plesiolebias altamira*, *Pituna xinguensis* and *Rivulus xinguensis*. Fortunately, *Pituna xinguensis* and *Plesiolebias altamira* were found occurring syntopically with *Maratecoara gesmonei*, and consequently will not be extirpated by the building of the Belo Monte dam. São Felix do Xingu is about 384 km in a straight line from Altamira, and very likely, more habitats for annual fishes exist in the intervening area.

The type locality of *Maratecoara gesmonei* is considerably distant from the other known localities of *Maratecoara* species, *i.e.*, 932 km from the type-locality of *M. lacortei*, 815 km from the type-locality of *M. splendida* and 640 km from the type-locality of *M. formosa* (Fig. 3). All *Maratecoara* species are only known from their type localities locations, with the exception for *M. lacortei*, which is known from several sites at the rio Araguaia at the city of Aruanã and its tributary, the rio das Mortes, and

downstream into the Ilha do Bananal. Although the genus probably has a natural patchy distribution, this disjunctness may be a sampling artifact, both due to the relatively little fieldwork directed to the search of annual fishes, and also due to a possible great contraction of available habitat for the species of the genus and for annual fishes as a whole caused by the massive destruction of the Cerrado vegetation domain in Central Brazil, which is being replaced by large monoculture plantations.

The occurrence of the new species *Maratecoara gesmonei* in the rio Xingu basin might be associated to the neotectonic activity across the Transbrasiliano Lineament area, a mega linear structure with about 2700 km, which begins in upper Paraguay River, crossing the Brazilian Shield to the northeast coast of Brazil, which also is hypothesized as the geological drive behind current ranges of other fish taxa occurring across shield-draining river basins of Central Brazil (Lima & Ribeiro 2011) (Fig. 5). These authors reported that the distribution of several fish taxa was probably shaped by several headwaters captures generated by neotectonic activity between the Pantanal depression and Araguaia-Tocantins depression, which probably allowed a interchange of fish populations among distinct river basins. Other genera of the subtribe Plesiolebiina, like *Plesiolebias* and *Pituna*, possess a similar distribution along the Transbrasilian Lineament and they also occur in the middle and lower rio Xingu region (Fig. 6).

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