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***Rivulus paracatuensis* n. sp. (Cyprinodontiformes: Rivulidae): a new rivuline species from the Rio São Francisco basin, Brazil**

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Abstract

Rivulus paracatuensis n. sp. is described from a small stream in the Rio Paracatú floodplains, Rio São Francisco basin, Minas Gerais, Brazil. It was previously misidentified as *R. decoratus*, the only other species of the genus occurring in the São Francisco basin, but described from Ibiraba, Bahia, which is about 1,000 km north of the Rio Paracatú. The new species is easily distinguished from *R. decoratus* by having more dorsal, caudal and pectoral fin rays, more vertebrae, more scales in the longitudinal series and more scale rows around the caudal peduncle, a wider basihyal, and a distinct male colour pattern.

Resumo

Rivulus paracatuensis n. sp., coletada em um pequeno riacho na várzea do rio Paracatú, bacia do rio São Francisco, Minas Gerais, Brazil, é descrita. Ela foi antes equivocadamente identificada como *R. decoratus*, a única outra espécie do gênero que ocorre na bacia do São Francisco, mas descrita de Ibiraba, Bahia, que está cerca de 1.000 km a Norte do rio Paracatú. A nova espécie se distingue facilmente de *R. decoratus* por possuir mais raios nas nadadeiras dorsal, caudal e peitoral, mais escamas na série longitudinal e mais séries de escamas em torno do pedúnculo caudal, basi-hial mais largo e um distinto padrão de colorido em macho.

Zusammenfassung

Rivulus paracatuensis n. sp. wird von einem kleinen Fluss im Überschwemmungsgebiet des Rio Paracatú, Rio São Francisco-Becken (Minas Gerais, Brasilien) beschrieben. Diese Art war vormals fälschlich als *R. decoratus* identifiziert, die einzige andere Art in dieser Gattung, die zwar im Rio São Francisco-Becken vorkommt, aber von Ibiraba, Bahia (ungefähr 1.000 km nördlich vom Rio Paracatú), beschrieben wurde. Die neue Art ist leicht von *R. decoratur* zu unterscheiden; sie hat mehr Rücken-, Schwanz- und Brustflossen-

strahlen, mehr Rückenwirbel, sowie mehr Schuppen in der Längsserie und auch um den Schwanzstiel herum. Ebenfalls anwesend ist ein breiteres Zungenbein, sowie ein anderes Farbmuster in männlichen Tieren.

Résumé

Rivulus paracatuensis n. sp. est décrit venant d'un petit cours d'eau dans les zones inondables du Rio Paracatú, bassin du Rio São Francisco, Minas Gerais, Brésil. Il fut autrefois erronément identifié sous le nom de *R. decoratus*, la seule autre espèce du genre vivant dans le bassin du São Francisco, mais décrit d'Ibiraba, Bahia, qui se trouve à 1000 km au nord du Rio Paracatú. L'espèce nouvelle se distingue facilement de *R. decoratus* par un nombre plus élevé de rayons à la dorsale, la caudale et aux pectorales, plus de vertèbres, plus d'écaillles dans les séries longitudinales et plus de rangées d'écaillles autour du pédoncule caudal, un basihyal plus large et un patron de coloration propre aux mâles.

Sommario

Rivulus paracatuensis n. sp. viene descritto da esemplari raccolti in un piccolo corso d'acqua dell'alveo del Rio Paracatú, bacino del Rio São Francisco, Minas Gerais, Brasile. Precedentemente confuso con *R. decoratus*, l'unica altra specie del genere presente nel bacino del Rio São Francisco, ma descritta ad Ibiraba, Bahia, a circa 1000 km a nord del Rio Paracatú. La nuova specie si distingue da *R. decoratus* per avere un maggior numero di raggi nelle pinne dorsale, caudale e pettorali, più vertebre, più scaglie in linea longitudinale, più file di scaglie attorno al peduncolo caudale, il basiale più largo e una diversa livrea nel maschio.

Introduction

The Rio São Francisco basin is the fourth largest river basin in South America, its main course extending for about 3,100 km. It drains an area of 631,133 km² in north-eastern Brazil, mostly within the Caatinga, a semi-arid region. A high degree of fish diversity and species endemism has been recorded (e. g. Travassos, 1960; Britski *et al.*, 1988), but until 1988 no rivulid had been found in this basin. Surprisingly, recent

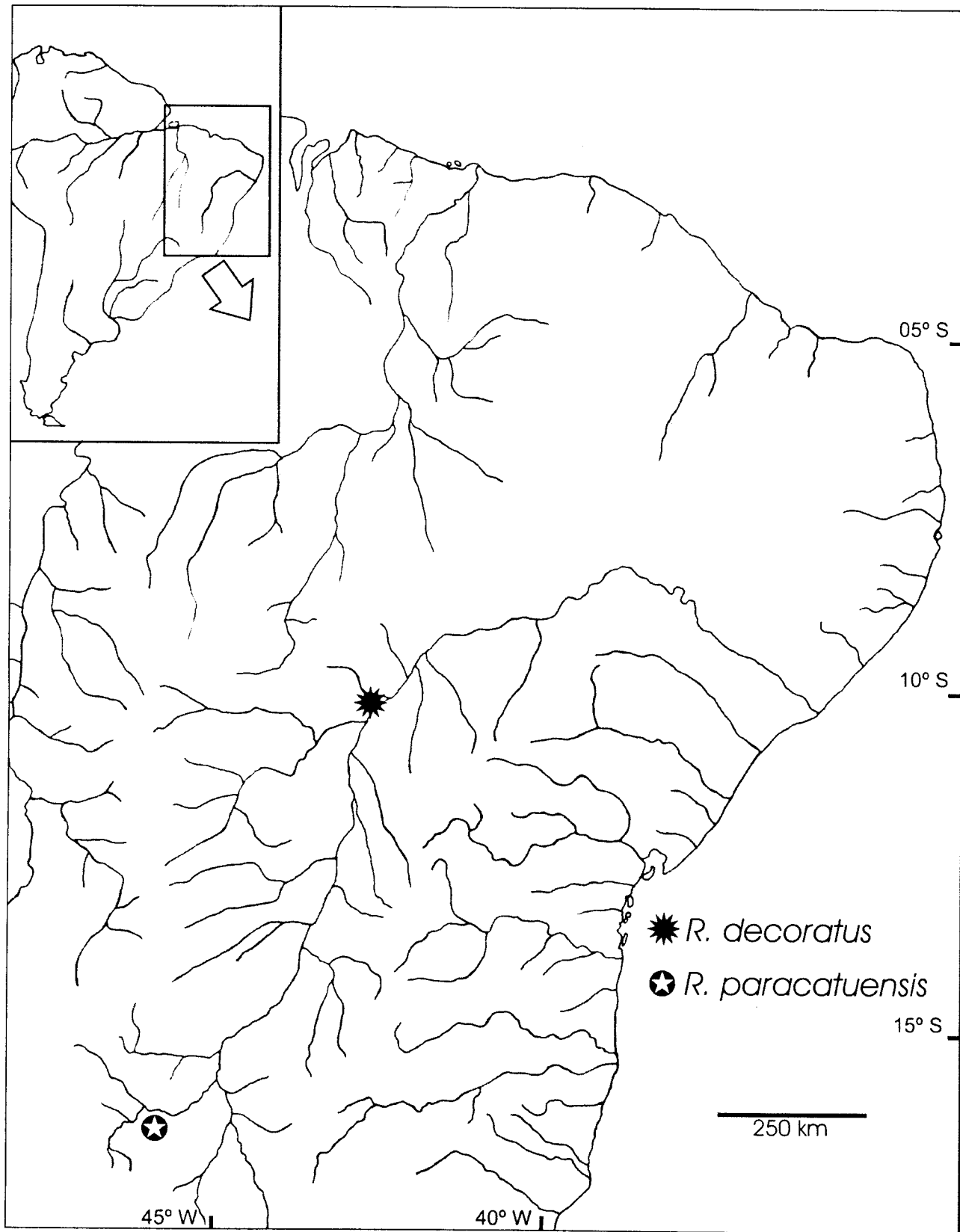


Fig. 1. Geographic distribution of *Rivulus paracatuensis* and *R. decoratus*.

research directed at sampling special habitats has revealed a diversified assemblage of endemic rivulids, with a total of 27 species (Costa, 2001, in press; see also many other references in these two papers). However, although the annual fish genera *Simpsonichthys* Carvalho and *Cynolebias* Steindachner are represented by several species, some of which are widespread over a vast area and occur in many localities, *Rivulus* Poey is represented by a single species, *R. decoratus* Costa. This species is recorded from only a few localities in the São Francisco basin (Costa, 1995a), contrasting with other species of *Rivulus* endemic to neighbouring river basins (i. e. Tocantins and Paraná), where they are found at numerous sites and in almost all shallow aquatic freshwater habitats.

Rivulus decoratus was first described on the basis of specimens collected in Ibiraba, northern Bahia (Costa, 1989). Subsequently, *R. decoratus* was considered to be a member of a clade termed the *R. punctatus* complex and was included in the taxonomic revision of this group (Costa, 1995a). During the final stages of the preparation of this paper, a new population was found in the Rio Paracatú floodplains, western Minas Gerais, about 1,000 km in a straight line from the type locality (Fig. 1). Specimens of this population were at that time identified as *R. decoratus* (Costa, 1995a), despite having a distinct colour pattern. Subsequent morphological comparison has provided strong evidence supporting recognition of the population from the Paracatú floodplains as a new species, described here.

Materials and methods

Measurements and counts follow Costa (1995b). Measurements are presented as percentages of standard length (SL), except for parts of the head, which are expressed as percentages of head length. Counts of pectoral and caudal fin rays and vertebrae were made only on cleared and stained specimens (c&s) prepared in accordance with Taylor and Van Dyke

(1985); in vertebral counts, the compound caudal centrum was counted as a single element. Selected osteological features presented in the description are those with some relevance for clarifying phylogenetic relationships among species of *Rivulus*, as described and discussed by Costa (1998). Nomenclature for frontal squamation patterns and identification of homologous scales follows Hoedeman (1958); terminology for cephalic neuromasts follows Costa (2001). Comparative material is listed in Costa (1995a). Institutional abbreviations are: MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, and UFRJ, Universidade Federal do Rio de Janeiro, Rio de Janeiro.

Rivulus paracatuensis n. sp.

(Fig. 2; Table I)

Rivulus decoratus non *R. decoratus* Costa, 1989: Costa, 1995a: 221-223 (misidentification).

Holotype: MCP 29639, male, 22.5 mm SL; Brazil: Estado de Minas Gerais, stream in Rio Paracatú floodplains near Brasilândia de Minas, road MG 181, Rio São Francisco basin, approximately 17°00'00"S 46°00'00"W; collected by Gilberto C. Brasil, 1 May 1994.

Paratypes: MCP 29640, one female, 19.7 mm SL; UFRJ 2290, two males, 19.0-19.9 mm SL, and one female, 21.1 mm SL; UFRJ 2291, one male 23.9 mm SL, and one female 19.4 mm SL (c&s); same data as holotype.

Diagnosis

Similar to *R. zygonectes* Myers, *R. punctatus* Boulenger, *R. violaceus* Costa, *R. modestus* Costa, *R. pictus* Costa, and *R. decoratus* Costa, and distinguished from all other species of the genus by unpaired fins of female with contrasting dark grey marks and



Fig. 2. *Rivulus paracatuensis*, MCP 29637, male, holotype, 22.5 mm SL; Brazil: Minas Gerais: Brasilândia de Minas. Photo by W. J. E. M. Costa.

Table I. Morphometric data of *Rivulus paracatuensis* n. sp.

		Males		Females	
	Holotype	Paratypes			
	MCP 29637	UFRJ 2290	UFRJ 2290	UFRJ 2290	MCP 29638
SL [mm]	22.5	19.9	19.0	21.1	19.7
In percents of standard length					
Body depth	21.9	23.3	22.2	21.0	21.3
Caudal peduncle depth	13.8	14.8	14.1	13.0	13.3
Predorsal length	75.0	76.9	78.0	81.1	77.8
Prepelvic length	53.3	55.9	55.3	56.7	57.1
Length of dorsal fin base	12.6	12.8	11.8	9.3	10.2
Length of anal fin base	22.2	20.0	20.0	18.1	17.9
Caudal fin length	36.3	-	38.4	35.1	35.2
Pectoral fin length	21.1	20.6	21.2	18.8	18.9
Pelvic fin length	11.7	12.6	11.9	8.5	10.1
Head length	26.7	28.2	28.2	27.5	27.6
Head depth	19.0	20.2	18.3	18.1	18.5
Head width	19.8	20.9	20.1	20.0	20.5
In percents of head length					
Snout length	15.4	15.7	14.4	15.3	14.0
Lower jaw length	23.2	20.1	17.4	19.8	17.3
Eye diameter	33.7	35.5	32.1	32.4	33.9

black margins with white to yellowish white ground colour (vs. never a similar colour pattern), dark brown to black postorbital stripe on head midline (vs. postorbital stripe absent or present below head midline), and first epibranchial L-shaped (vs. I-shaped). Similar to *R. pictus*, but distinguished from *R. zygonectes*, *R. punctatus*, *R. violaceus*, *R. modestus*, and *R. decoratus*, by caudal fin of male yellow with dark bars, without distinct colours on edges (vs. having white edge in *R. punctatus*, distinctive yellow stripe on dorsal and ventral margins in *R. zygonectes* and *R. violaceus*, no markings in *R. modestus*, and dark brown stripe on ventral edge in *R. decoratus*). Differs from *R. pictus* by usually having frontal squamation D-patterned, sometimes E-patterned (vs. usually F, sometimes E), side of body pale blue in male (vs. bright greenish blue), and dorsal and caudal fins of male with dark grey bars (vs. red). Further distinguished from *R. decoratus*, the only congener also occurring in the São Francisco basin, by more dorsal fin rays (9-10 vs. 7-8), more caudal fin rays (31-33 vs. 26-27), more pectoral fin rays (13 vs. 11-12), more vertebrae (30 vs. 28-29), more scales in longitudinal series (31-33 vs. 26-28), more scale rows around caudal peduncle (16 vs. 14), and wider basihyal (width about 60% of longitudinal length, vs. about 35%).

Description

Morphometric data for holotype and four paratypes are given in Table I. Male larger than female, largest male 23.9 mm SL. Dorsal profile slightly convex between snout and end of dorsal fin base, gently con-

cave on caudal peduncle. Ventral profile slightly convex from lower jaw to end of anal fin base, nearly straight on caudal peduncle. Body slender, subcylindrical, body depth slightly greater than body width. Greatest body depth on vertical through pelvic fin base. Jaws short, snout blunt.

Tip of dorsal and anal fins rounded. Caudal fin elliptical. Pectoral fin elliptical, short, its posterior margin extending to vertical anterior to pelvic fin base. Pelvic fin short, its tip reaching base of first anal fin ray in male, and anus in female. Dorsal fin origin on vertical between base of 9th and 10th anal fin rays. Dorsal fin rays 9-10, anal fin rays 13-14, caudal fin rays 31-33, pelvic fin rays 6-7, pectoral fin rays 13.

Scales large, cycloid. Body and head entirely scaled, except on chin. Frontal squamation usually D-patterned, sometimes E-patterned, scales arranged circularly around central A-scale. No scales on dorsal and anal fin bases. Body squamation extending slightly onto caudal fin base. Longitudinal series of scales 31-33, transverse series of scales 8, scale rows around caudal peduncle 16. Contact organs absent. Supraorbital neuromasts 3 + 3.

Ventral process of angulo-articular narrow and short. Dorsal arm of preopercle short and pointed. Basihyal approximately triangular, its greatest width about 60 % of its total longitudinal length; basihyal cartilage short, about 20% of its total longitudinal length. Six branchiostegal rays. No teeth on second pharyngobranchial. Deep gap lateral to anterior condyle of second pharyngobranchial. Distal region of first epi-

branchial bent at angle of 90° to its main axis. Teeth along proximal and median portions of dorsal surface of fourth ceratobranchial. Gill-rakers of first branchial arch 1 + 7. Vomerine teeth 3-4. Interhyal not ossified. Posttemporal and supracleithrum fused. Ventral process of posttemporal absent. Dorsal and ventral hypural plates separated by interspace. Total vertebrae 30.

Coloration in life: Male: side of body light yellowish brown with faint light blue iridescence; stripe along midline, between head and anterior portion of caudal peduncle, dark brown in its anteriormost part, becoming pale grey posteriorly; oblique rows of red dots along flank, forming chevron-like marks, with vertex directed anteriorly, on posterior portion of flank. Head light yellowish brown, opercular region with faint light blue iridescence; lower jaw dark grey; dark brown stripe between point just posterior to posterior orbital edge and humeral region, continuous with lateral stripe on body. Iris yellow. Dorsal and caudal fins yellow with grey bars. Anal fin yellow, base light blue with red bars. Pectoral fin hyaline. Pelvic fin yellow.

Female: side of body light yellowish brown with mid-lateral stripe as in male, and oblique rows of reddish brown dots. Head light yellowish brown, lower jaw dark grey, and dark brown stripe posterior to orbit as in male. Iris yellow. Unpaired fins yellowish white with grey bars; distal border of dorsal and anal fins, and entire border of caudal fin dark grey; black spot on upper portion of caudal fin base. Pectoral fin hyaline. Pelvic fin yellowish white.

Etymology

The name *paracatuensis* refers to the type locality of the new species, the rio Paracatú floodplains.

Distribution

Known only from the type locality, the floodplains of the Rio Paracatú, Rio São Francisco basin, Brazil (Fig. 1).

Discussion

Rivulus paracatuensis exhibits synapomorphies established by Costa (1995a, 1998) to define a clade which includes *R. zygometes*, *R. punctatus*, *R. violaceus*, *R. modestus*, *R. pictus*, and *R. decoratus*: unpaired fins of female with dark grey marks and black margins strongly contrasting with white to yellowish white background, dark brown to black postorbital stripe on head midline, and distal portion of first epibranchial bent at angle of 90°. This species assemblage is endemic to central South America (Costa, 1995a), which includes south-eastern Amazonian tributaries (*R. modestus*, *R. violaceus*, and *R. zygometes*), Paraguay and Uruguay basins (*R. punctatus*), Paraná basin (*R. pictus*) and São Francisco basin (*R. decoratus* and *R. paracatuensis*). Relationships within this clade are unclear at the present time.

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