

Rivulus jurubatibensis, a new aplocheiloid killifish from the southeastern Brazilian coastal plains (Cyprinodontiformes: Rivulidae)

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Rivulus jurubatibensis, a new species of the *Rivulus santensis* group, from a coastal swamp close to the Lagoa do Pires, Quissamã, Rio de Janeiro, southeastern Brazil, is described. It is distinguished from all other species of the *R. santensis* group by having fewer scales in the longitudinal series. *Rivulus jurubatibensis* is considered to be closely related to *R. nudiventris* by both sharing two unique color patterns: caudal fin light yellow with a broad gray stripe on the whole fin margin in males and a small horizontally elongated black spot on the dorsal portion of the caudal-fin base in females. *Rivulus jurubatibensis* is distinguished from *R. nudiventris* by the presence of pelvic fin and by having fewer caudal-fin rays and fewer anal-fin rays.

Rivulus jurubatibensis, uma nova espécie do grupo *Rivulus santensis*, de um alagado junto da Lagoa do Pires, Quissamã, Rio de Janeiro, sudeste do Brasil, é descrita. Ela se distingue de todas as outras espécies do grupo *R. santensis* por possuir menos escamas na série longitudinal. *Rivulus jurubatibensis* é considerada ser estreitamente relacionada a *R. nudiventris* pelas duas compartilharem dois padrões de colorido exclusivo: nadadeira caudal amarelo clara com uma larga faixa cinza em toda a margem da nadadeira e uma pequena mancha negra alongada horizontalmente na porção dorsal da base da nadadeira caudal em fêmeas. *Rivulus jurubatibensis* se distingue de *R. nudiventris* pela presença de nadadeira pélvica e por possuir menos raios na nadadeira caudal e menos raios na nadadeira anal.

Introduction

Rivulus, the most diversified genus of Neotropical aplocheiloid killifishes, comprises over 100 nominal species occurring in streams and swamps of most Middle and South America river basins. Although *Rivulus* possibly is not a monophyletic genus, it includes well corroborated clades (e.g., Hrbek & Larson, 1999; Murphy et al., 1999; Costa, 2006). Among these clades, the *R. santensis* species group is diagnosed by two derived fea-

tures: ventral process of the angulo-articular curved (vs. straight) and infraorbital neuromasts numerous (1 + 19-28 + 1) and arranged in a zigzag pattern (vs. 1 + 9-16 + 1, aligned around orbit) (e.g., Costa, 1998, 2007a). It is the only clade of *Rivulus* endemic to the coastal plains of eastern Brazil and it includes eight valid species: *R. depressus*, *R. haraldsiolii*, *R. janeiroensis*, *R. lazzarotoi*, *R. luelingi*, *R. nudiventris*, *R. santensis*, and *R. simplicis* (Berkenkamp, 1984; Seegers, 1984; Costa, 1991, 2004, 2007a; Costa & Brasil, 1991). A new species col-

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lected in a Restinga freshwater swamp close to a small lagoon isolated from river basins, in the coastal plains of northern Estado do Rio de Janeiro, southeastern Brazil, is herein described.

Material and methods

Measurements and counts follow Costa (1995). Measurements are presented as percentages of standard length (SL), except for those related to head morphology, which are expressed as percentages of head length. Fin-ray counts include all elements. Number of vertebrae, gill-rakers, and caudal-fin rays were recorded only from cleared and stained specimens; the compound caudal centrum was counted as a single element. Osteological preparations were made according to Taylor & Van Dyke (1985). Terminology for frontal squamation follows Hoedeman (1958) and for cephalic neuromast series Costa (2001). Material is deposited in Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro (UFRJ).

Rivulus jurubatibensis, new species (Figs. 1-2)

Holotype. UFRJ 6611, male, 23.7 mm SL; Brazil: Estado do Rio de Janeiro: Município de Quissamã: swamp close to Lagoa do Pires, Parque Nacional de Jurubatiba, 22°10'50"S 41°23'41"W; W. J. E. M. Costa, B. B. Costa & C. P. Bove, 8 December 2006.

Paratypes. UFRJ 6612, 3 males, 18.9-20.9 mm SL, 5 females, 19.1-22.9 mm SL; UFRJ 6613, 2 males, 19.6-20.6 mm SL, 2 females, 22.1-22.4 mm SL (c&s); all collected with holotype. – UFRJ 6242, 1 male, 25.7 mm SL, and 7 females, 18.4-25.6 mm SL; same locality; C. P. Bove & A. D. R. Moreira, 14 Sep 2005.

Diagnosis. *Rivulus jurubatibensis* is distinguished from all other species of the *Rivulus santensis* group by having 30-31 scales in the longitudinal series (vs. 32-36). It is similar to *R. nudiventris* and distinguished from all other species of the *R. santensis* group in having the caudal fin light yellow, with a dark gray broad margin along the whole fin (vs. dark gray broad margin absent in *R. depressus*, *R. lazzarotoi*, and *R. simplicis*; dark gray broad margin restricted to dorsal and ventral

margins of the caudal fin in *R. janeiroensis*, *R. santensis*, and *R. haraldioli*; caudal fin with black broad margin, middle with bright green and dark reddish brown to black longitudinal lines in *R. luelingi*), and a small, horizontally elongated black spot on the dorsal portion of the caudal-fin base in females (vs. rounded or triangular). *Rivulus jurubatibensis* differs from *R. nudiventris* by the presence of pelvic fin (vs. absence) and by having fewer caudal-fin rays (25-29 vs. 30-31) and fewer anal-fin rays (12-13 vs. 14).

Description. Morphometric data appear in Table 1. Largest male examined 25.7 mm SL; largest female examined 25.6 mm SL. Dorsal profile slightly convex from snout to end of dorsal-fin base, approximately straight on caudal peduncle. Ventral profile about straight to slightly convex from lower jaw to end of anal-fin base, nearly straight on caudal peduncle. Body slender, sub-cylindrical anteriorly, slightly deeper than wide, to compressed posteriorly. Greatest body depth at vertical just in front to pelvic-fin base. Jaws short, snout rounded.

Extremity of dorsal and anal fins rounded. Caudal fin rounded to subtruncate. Pectoral fin rounded, posterior margin reaching vertical at about 80 % of length between pectoral-fin and pelvic-fin bases in males, about 70 % in females. Pelvic fin short and elliptical, tip reaching between urogenital papilla and base of 1st anal-fin ray in males, reaching between anus and urogenital papilla in females. Pelvic-fin bases medially in close proximity. Dorsal-fin origin on vertical between base of 10th and 11th anal-fin rays, and between neural spines of 20th and 22nd vertebrae. Anal-fin origin between pleural ribs of 14th and 16th vertebrae. Dorsal-fin rays 6-8; anal-fin rays 12-13; caudal-fin rays 25-29; pectoral-fin rays 13; pelvic-fin rays 5.

Scales small, cycloid. Trunk and head entirely scaled, except anterior ventral surface of head. Body squamation extending over anterior 30 % of caudal-fin base; no scales on dorsal and anal-fin bases. Frontal squamation E-patterned; E-scales not overlapping medially; scales arranged in regular circular pattern around A-scale without exposed margins; anterior portion of G-scale overlapping H-scale; transverse row of scales anterior to H-scale. Three to five supraorbital scales. One minute contact organ per scale on middle portion of flank in males. Longitudinal series of scales 30-31; transverse series of scales 7;



Fig. 1. *Rivulus jurubatibensis*, UFRJ 6611, holotype, male, 23.7 mm SL; Brazil: Estado do Rio de Janeiro: Quissamã (a few hours after collection).



Fig. 2. *Rivulus jurubatibensis*, UFRJ 6612, paratype, female, 22.9 mm SL; Brazil: Estado do Rio de Janeiro: Quissamã (a few hours after collection).

scale rows around caudal peduncle 16. No contact organs on fins.

Cephalic neuromasts: supraorbital 3+3, parietal 1, anterior rostral 1, posterior rostral 1, infraorbital 1+19-25+1, preorbital 2, otic 1, post-otic 1-2, supratemporal 1, median opercular 1, ventral opercular 2, preopercular 2+4, mandibular 4+2, lateral mandibular 1-2, paramandibular 1. One neuromast by scale of lateral line, sometimes neuromast absent in some scales; two neuromasts on caudal-fin base.

Basihyal subtriangular, greatest width about 40% length; basihyal cartilage about 20% of total

basihyal length. Six branchiostegal rays. One second pharyngobranchial tooth. Gill-rakers of first branchial arch 1+7. One vomerine tooth. Ventral process of posttemporal absent. Total vertebrae 31-32.

Coloration. Males. Side of body light green with longitudinal rows of pink dots. Dorsum light brown. Venter yellow. Side of head light brown to dark gray above horizontal line through ventral margin of orbit, yellow below eye, golden on ventral portion of opercular region. Jaws dark gray. Iris light yellow. Dorsal fin pale blue. Anal

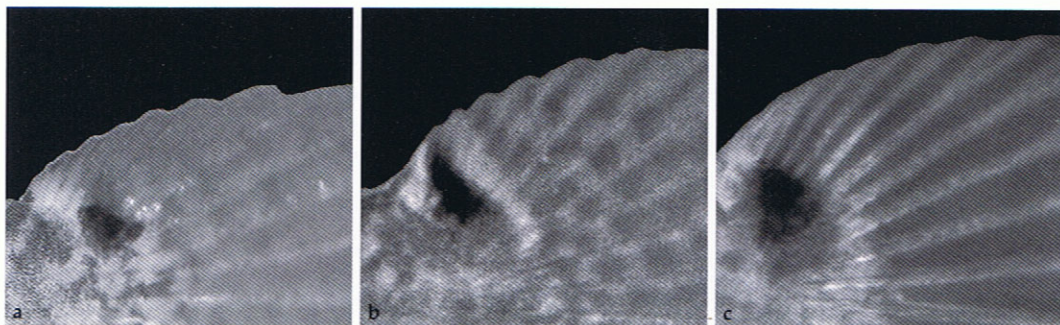


Fig. 3. Anterodorsal portion of female caudal fin, left side, of: a, *Rivulus jurubatibensis*, UFRJ 6612, paratype, 22.9 mm SL; Brazil: Estado do Rio de Janeiro: Quissamã; b, *R. santensis*, UFRJ 6326, 31.4 mm SL; Brazil: São Paulo: Iguape; c, *R. luelingi*, UFRJ 6347, 26.4 mm SL; Brazil: Paraná: Guaratuba.

fin yellow, basal portion light blue; dark reddish gray stripe on distal margin. Caudal fin light yellow with broad dark reddish dorsal and ventral margins, and pale gray posterior margin. Pectoral fin orangish hyaline. Pelvic fin yellow with narrow, dark reddish gray anterior margin.

Females. Side of body light purplish brown, with pale gray dots; vertical series of dark brown spots on dorsal portion of flank. Dorsum light brown. Venter pale yellow. Side of head light brown, postorbital region dark brown, ventral

portion of opercle and suborbital region pale yellow. Jaws dark gray. Iris light brown. Dorsal fin hyaline with two transverse dark gray stripes on basal region. Anal fin pale orange, basal portion light blue. Caudal fin hyaline to pale orange on ventral portion, with transverse rows of gray dots; small horizontally elongated black spot on dorsal portion of caudal-fin base, not reaching fin margin. Paired fins hyaline.

Distribution and habitat. Known only from the type locality, a freshwater swampy coastal area close to a lagoon, the Lagoa do Pires, and about 100 m from the beach, in the Parque Nacional de Jurubatiba, Município de Quissamã, Rio de Janeiro, Brazil. Lagoa do Pires is part of a series of lagoons close to the sea, isolated from river basins. This is an open area of Restinga vegetation, the swamp containing dense aquatic vegetation. The water was clear and acid (pH 5.28).

Etymology. The name *jurubatibensis* denotes the occurrence of the new species in the Parque Nacional de Jurubatiba.

Discussion

Rivulus jurubatibensis seems to be a small species, the largest known specimen with 25.7 mm SL. Specimens about 18 mm SL were sexually mature, presenting adult color patterns and females bearing well-developed gonads. This small adult size contrasts with all other species of the *R. santensis* species group, which reach about 35-45 mm SL as the maximum adult size. The lowest ranges of meristic data in *R. jurubatibensis* among all species

Table 1. Morphometric data of *Rivulus jurubatibensis*. H, holotype.

	H UFRJ 6611	males (n=3)	females (n=5)
Standard length (mm)	23.7	20.9-25.7	21.9-25.6
Percent of standard length			
Body depth	21.7	19.6-23.2	20.4-21.9
Caudal peduncle depth	13.7	12.8-13.9	12.5-13.8
Predorsal length	81.9	78.0-81.9	78.4-82.4
Prepelvic length	58.4	54.9-58.4	54.6-58.5
Length of dorsal-fin base	10.9	9.2-10.9	8.5-10.4
Length of anal-fin base	21.3	18.7-21.3	17.8-20.1
Caudal-fin length	40.9	37.4-40.9	37.4-41.7
Pectoral-fin length	22.6	19.3-22.6	19.5-22.0
Pelvic-fin length	10.1	9.9-10.1	6.9-8.2
Head length	28.5	26.4-28.5	26.4-27.5
Percent of head length			
Head depth	63.5	63.5-67.4	62.4-67.4
Head width	71.2	71.2-78.5	76.8-84.5
Snout length	12.4	11.6-13.6	12.2-13.8
Lower jaw length	23.2	17.5-23.2	18.5-20.4
Eye diameter	36.4	33.1-36.4	34.5-37.6

of the *R. santensis* species group (dorsal-fin rays 6-8 vs. 7-10; anal-fin rays 12-13 vs. 13-16; scales of longitudinal series 30-31 vs. 32-36) may be related to a miniaturization event in *R. jurubatibensis*. It also is the only species of this group inhabiting an open vegetation swamp, since all other species are uniquely found in streams and swamps within or at the border of dense rain forests. *Rivulus jurubatibensis* is uniquely known from a swamp close to a lagoon, in a vast area of well preserved coastal Restinga vegetation, where the dense rain forests are absent.

Among species of the *R. santensis* species group, *R. jurubatibensis* is tentatively considered more closely related to *R. nudiventris*. Both species are two elements of the color pattern not found in other species of the group. The first one is the pattern of caudal fin in males, which is light yellow, with a dark gray wide stripe along the whole fin margin. In *R. jurubatibensis*, the stripe is darker and reddish gray on the dorsal and ventral margins, and pale gray on the posterior margin, while in *R. nudiventris*, the whole stripe has the same color (dark gray). The broad dark gray stripe margin on the caudal fin is absent in *R. depressus*, *R. simplicis* and *R. lazzarotoi* (Costa, 1991, 2004, 2007a). In *R. santensis*, *R. haraldsiolii* and *R. janeiroensis*, the broad dark stripe is restricted to the dorsal and ventral margins of the caudal fin (Costa, 1991, 2007b). In *R. luelingi* there is a broad black margin on the whole fin, but the entire fin is dark red to black with bright greenish yellow stripes, constituting a different condition (Costa, 2007b).

The second shared element of the color pattern is the presence of a small horizontally elongated black spot on the dorsal portion of the caudal-fin base in females. Both in *R. jurubatibensis* and *R. nudiventris* the spot is approximately rounded, the horizontal length longer than the vertical one, and the spot does not touch the fin margin (Fig. 3a). In the other species of the group, the caudal spot is rounded or triangular, with an extension reaching the dorsal margin of the fin (Fig. 3b) (e.g., Costa, 2004, 2007a). Exceptions are *R. depressus*, in which the spot is absent (Costa, 1991), and *R. luelingi*, with a large rounded spot not reaching the fin margin (Fig. 3c) (Costa, 2007b).

Acknowledgements

I am grateful to C. P. Bove and B. B. Costa for valuable help in the collecting trip. Part of the material was collected by C. P. Bove and A. D. R. Moreira. The manuscript benefited from the criticisms of anonymous reviewers. This study was supported by FAPERJ (Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro - Programa Cientista do Nosso Estado) and CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico - Ministério de Ciência e Tecnologia). Collecting permits were obtained from IBAMA (lic. 273/2006).

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Received 5 May 2008
Revised 23 July 2008
Accepted 24 July 2008