

A new *Papiliolebias* species (Teleostei: Cyprinodontiformes: Rivulidae) from Bolivian Amazon

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Abstract

Papiliolebias francescae, new species, is described based on specimens collected in a seasonal pool in Rio San Pablo drainage, Departamento Santa Cruz, central Bolivia. It differs from its congeners by the following unique features in males: dorsal and anal fins pointed; oblique, chevron-shaped, blue-gray and dark red stripes in close proximity on flanks; proximal half dorsal and anal fin whitish with broad dark red elongated spots; caudal fin with two or three transverse rows of dark red spots; pupil with anterior pointed extension.

Zusammenfassung

Die neue Art *Papiliolebias francescae* wird anhand von Exemplaren beschrieben, die in einem zeitbegrenzten Tümpel im Einzugsgebiet des Flusses San Pablo im Departamento Santa Cruz in Zentralbolivien gesammelt wurden. Sie unterscheiden sich von den anderen Vertretern der Gattung durch folgende Kennzeichen der Männchen: gepunktete Rücken- und Afterflosse; dicht stehende schräge, angewinkelte blaugraue und dunkelrote Streifen auf den Seiten; die körpernahe Hälfte der Rücken- und Afterflosse weißlich mit breiten dunkelroten länglichen Flecken; Schwanzflosse mit zwei oder drei Querreihen dunkelroter Flecken; nach vorne spitz geformte Pupille.

Résumé

Papiliolebias francescae, nouvelle espèce, est décrit sur base de spécimens collectés dans une mare temporaire dans le drainage du Rio San Pablo, Departamento Santa Cruz, en Bolivie centrale. Il se distingue de ses congénères par les caractéristiques uniques suivantes chez les mâles: dorsale et anale pointues; des lignes obliques, en forme de chevrons, gris bleu et rouge foncé en patron serré sur les flancs; la moitié environ de la dorsale et de l'anale blanchâtre avec de larges taches allongées rouge foncé; la caudale avec deux ou trois rangées transversales de taches rouge foncé; la pupille pourvue d'une extension antérieure pointue.

Sommario

Papiliolebias francescae, nuove specie, è descritta sulla base

di esemplari raccolti in una pozza stagionale del bacino del Rio San Pablo, Dipartimento di Santa Cruz, Bolivia centrale. Si differenzia dai congeneri per le seguenti caratteristiche uniche nei maschi: pinna dorsale ed anale appuntite; strisce rosso scuro e blu-grigio oblique, ravvicinate e a forma di spina di pesce sui fianchi; metà prossimale della pinna dorsale e pinna anale biancastra con ampie macchie allungate rosso scuro; pinna caudale con due o tre file trasversali di macchie rosso scuro; pupilla con appuntita estensione anteriore.

INTRODUCTION

Annual fishes are specialized members of the killifish suborder Aplocheiloidei, with their entire biological cycle occurring in seasonal freshwater swamps of tropical and subtropical areas of Africa, Central and South America (Costa 1995; Wildekamp 2004; Domínguez-Castanedo et al. 2013). Typical annual fish habitats are temporary pools or swamps; the adults die when the habitat dries out and the next generation survives in the form of desiccation-resistant eggs encased in dry mud (Costa 1995; Watters 2009). The eggs hatch after the onset of the rainy season, develop and grow rapidly (Bláček et al. 2013, Costa 1998a).

Plesiolebiasini is a clade of small annual fishes, inhabiting temporary swamps of central and north-eastern South America (Brazil, Bolivia, Paraguay, and Argentina) (Costa 1998a-b; 2007; 2011; Azpelicueta et al. 2011; Nielsen & Brousseau 2014). It comprises five genera, namely, *Maratecoara* Costa, *Papiliolebias* Costa, *Pituna* Costa, *Plesiolebias* Costa, *Plesiolebias* Costa and *Stenolebias* Costa, with a total of 22 species. Molecular data are available for only five plesiolebiasine species (Hrbek & Larson 1999; Murphy et al. 1999) but a phylogenetic analysis based on a detailed survey of morphological characters of almost all species of the Plesiolebiasini was presented re-

cently by Costa (2011). The genus *Papiliolebias* comprises *P. bitteri*, from the Chaco region of the Paraguay River basin, Paraguay and Bolivia, *P. hatinne* from Rio Bermejo basin, Salta, Argentina, and *P. ashleyae* from upper Rio Mamoré basin, Bolivia.

In February 2014 specimens of a *Papiliolebias* species was collected in the Rio San Pablo drainage in the Rio Madeira River basin. It became apparent that these specimens represent a species unknown to science which is herein formally described.

MATERIAL AND METHODS

Measurements and counts were taken as described in Costa (1995). Measurements were made with a digital calliper, partly under a dissecting microscope, and rounded to the nearest 0.1 mm. If not stated otherwise, measurements are presented as percentages of standard length (SL), except for eye diameter and snout length, which are given as percentage of head length (HL).

Osteological preparations were made according to Taylor & Van Dyke (1985). Nomenclature for cephalic laterosensory series follows Costa (2001). Terminology for frontal squamation follows Hoedeman (1958); the E- scale was determined as that scale adjacent to the anteriormost neuromast of the posterior section of the supraorbital series.

Type material was deposited at the Museo Civico di Storia Naturale "Giacomo Doria", Genova (MSNG).

Papiliolebias francescae, n. sp.

(Figs 1-2; Table I)

Holotype: MSNG 57820, male, 21.3 mm SL: Bolivia, Departamento Santa Cruz, Ñuflo de Chávez Province, south of San Ramon, seasonal pools in the Rio San Pablo drainage, Rio Madeira River basin, 16°39'47"S 62°31'19"W, altitude 240 m, Roger Brousseau, Joe Bulterman, George Funkner, & Stefano Valdesalici, 20 February 2014.

Paratypes: MSNG 57801, four males, 19.4-21.8 mm SL, three females, 17.8-19.1 mm SL; one male, 20.1 mm SL, C&S, one female, 19.1 mm SL, C&S, collected with the holotype.

Diagnosis: *Papiliolebias francescae* differ from the others member of this genus by the following unique features: dorsal and anal fins pointed in males (vs. rounded); oblique, chevron-shaped, blue-gray and dark red stripes in close proximity on flanks of males (vs. never a similar color pattern); proximal half dorsal and anal fin whitish with broad dark red elongated spots (vs. proximal portion black with white spots); caudal fin with two or three transverse rows of dark red spots (vs. never a similar color pattern); pupil with anterior pointed extension (vs. rounded pupil).

Description: Morphometric data are presented in Table I. Largest male examined 21.8 mm SL; largest female examined 19.1 mm SL. Dorsal profile slightly convex from snout to end of dorsal-fin



Fig. 1. *Papiliolebias francescae*, MSNG 57820, male, holotype, 21.3 mm SL: Bolivia, San Pablo drainage (in life). Photo by S. Valdesalici.

Table I. Morphometric data of the type series of *Papiliolebias francescae*.

	Holotype	Males (N=5 including holotype)	Female (N=3)
Standard length (mm)	21.3	19.4-21.8	17.8-19.1
Percents of standard length			
Body depth	32.8	29.2-32.9	25.8-28.4
Caudal peduncle depth	15.9	14.6-15.9	13.0-15.8
Pre-dorsal length	66.6	65.9-71.1	65.1-67.2
Pre-anal length	58.6	55.1-60.9	58.1-60.6
Pre-pelvic length	47.8	43.8-48.6	42.4-47.1
Length of dorsal-fin base	17.8	15.9-22.9	15.7-16.2
Length of anal-fin base	28.6	27.8-31.6	26.2-27.5
Caudal-fin length	30.0	26.6-32.1	26.9-30.0
Pectoral-fin length	20.6	13.9-20.6	10.6-15.3
Pelvic-fin length	15.0	14.1-16.0	12.3-13.1
Head length	27.6	26.6-30.7	25.6-29.5
Percents of head length			
Head depth	91.5	75.0-91.5	73.0-93.8
Head width	40.6	34.3-40.6	32.6-36.7
Eye diameter	40.6	31.6-40.6	33.3-36.7

base, slightly concave on caudal peduncle. Ventral profile gently convex from lower jaw to anal-fin origin, nearly straight to slightly concave along caudal peduncle. Body moderately slender, compressed. Greatest body depth at level of pelvic-fin base. Jaws short, snout blunt. Dorsal and anal fins pointed in males, tip reaching to vertical through base of caudal fin in males, dorsal fin slightly pointed, anal fin rounded in females. Caudal fin rounded. Pectoral fins elliptical, posterior margin reaching urogenital papilla in males, reaching

pelvic fin base in females. Pelvic fins pointed, with tip reaching between base of 5th and 8th anal-fin ray in males; tip of each pelvic fin reaching base of 1st and 3rd anal-fin rays in females. Pelvic-fin bases separated. Dorsal-fin origin on vertical through base of 7th or 9th anal-fin rays, and between neural spines of 13th and 14th vertebrae. Anal-fin origin between pleural ribs of 11th and 12th vertebrae. Dorsal-fin rays 10-12; anal-fin rays 18-19; caudal-fin rays 22-25; pectoral-fin rays 12-14; pelvic-fin rays 7. Scales large, cycloid. Body and head entirely



Fig. 2. *Papiliolebias francescae*, MSNG 57801, female, paratype, 19.1 mm SL: Bolivia, San Pablo drainage (in life). Photo by S. Valdesalici.

scaled, except anterior ventral surface of head. Body squamation extending onto anterior 20% of caudal fin; no scales on dorsal and anal-fin bases. Frontal squamation F-patterned; E-scales not overlapping medially; frontal scales circularly arranged around A-scale. Longitudinal series of scales 23-27; transverse series of scales 11-12; scale rows around caudal peduncle 12-15. Cephalic neuromasts: supraorbital 4 + 4, parietal 2, anterior rostral 1, posterior rostral 1, infraorbital 1 + 1 + 1, preorbital 1, otic 1, postotic 1, preopercular 1, mandibular 2 or 4. One neuromast on center of each scale of lateral line of trunk, sometimes absent in few scales.

Basihyal subtriangular. Urohyal dorsal process branched. Six branchiostegal rays. First branchial arch gill-rakers 1+7-8. Ventral process of posttemporal present. Total vertebrae 26.

Color in life: Males: Sides of body light blue, with oblique, chevron-shaped, bluish-gray and dark red alternating stripes; dark metallic golden-green blotch on humeral region. Dorsum red brown with small black dots. Sides of head yellowish brown, opercle golden yellow, scale borders brownish; black suborbital bar. Jaws orange. Iris orange, with a black vertical bar through center of eye. Ventral part of the head light blue. Bran-

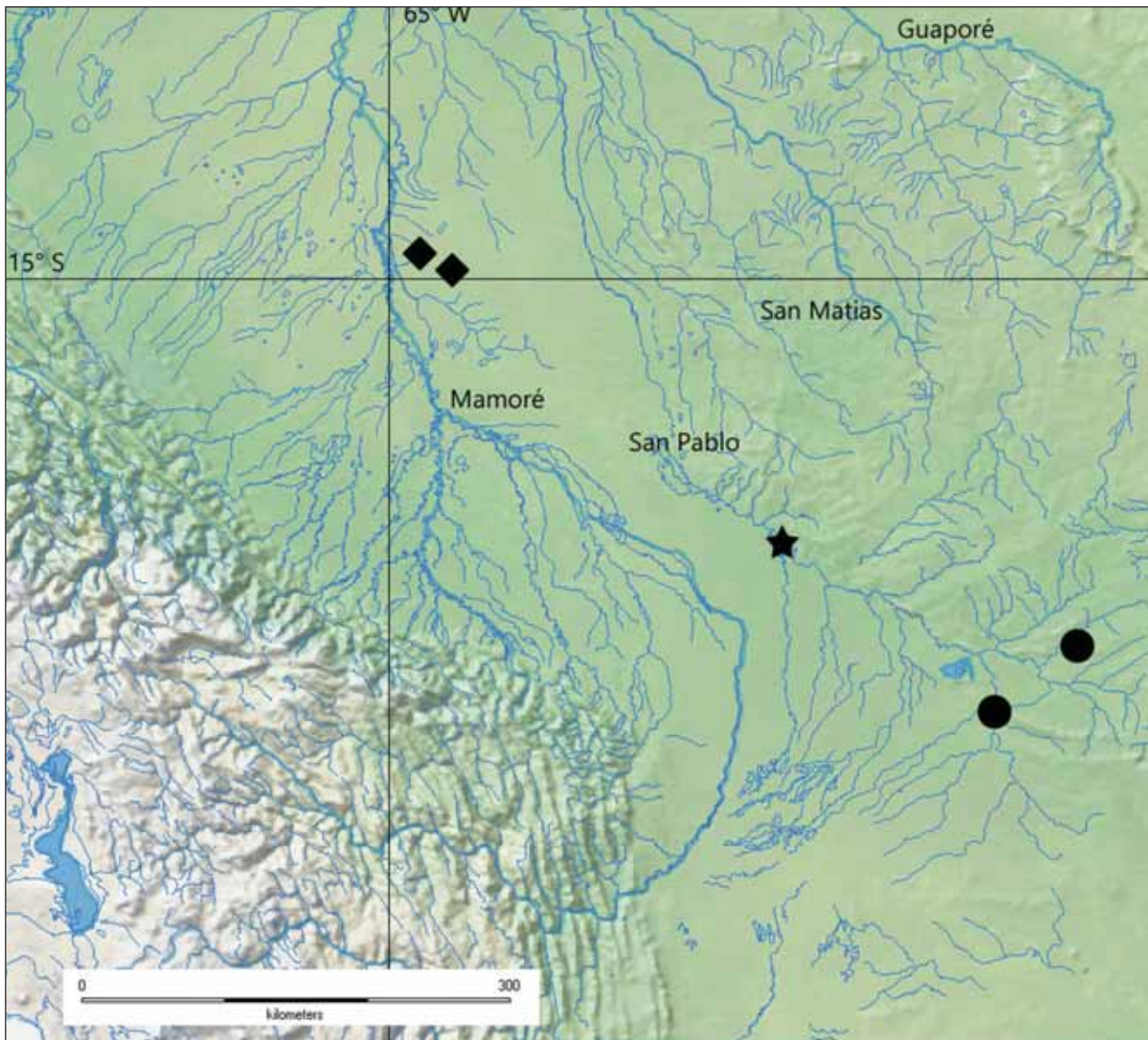


Fig. 3. Geographical distribution of *Papiliolebias francescae* (star), *Papiliolebias* sp. "Trinidad" (lozenge), and *Papiliolebias ashleyae* (circle).

chiostegal membranes red. Dorsal fin white to yellowish white on the basal half, with 4-5 dark red brown broad bars on basal and posterior portion of fin; distal portion dusky grey. Anal fin white to yellowish white on the basal half, with 5-6 dark red brown broad bars on basal and posterior portion of fin; median area reddish; distal anterior portion dark grey blue. Caudal fin yellowish hyaline on proximal portion with two or three transverse rows of pale reddish spots, often fused to form bars; gray hyaline on distal portion. Pectoral fins hyaline. Pelvic fins dusky gray, reddish on proximal portion.

Females: Sides of head and trunk light gray brownish. Dorsum light brown. Lower surface of head light gray to whitish. Opercular region pale golden. Humeral region golden. Black suborbital bar. Jaws light brown. Iris yellow orange, with black bar through center of eye. Unpaired fins hyaline, yellowish medio-basal portion. Paired fins hyaline.

Distribution: Known only from the type locality, seasonal pools in the Rio San Pablo drainage, Rio Madeira basin, central-eastern Bolivia (Fig. 3).

Habitat: *Papiliolebias francescae* was found in a quite shallow (about 0.40-1.0 m deep), temporary pool about 60 meters long and 10 meters wide, with clear water and litter at the bottom.

Other fish present were an undescribed *Trigonectes* species and unidentified catfishes and tetras (Fig. 4).

Etymology: Named in honor of Francesca Fontana, wife of one of the discoverers and authors (SV), in recognition to her love, friendship and support over the years.

DISCUSSION

The genus *Papiliolebias* was defined by four synapomorphies (Costa 1998a): unpaired fins dark blue and with a white line along distal margin of anal fin in males, nine pelvic fin rays, and a metallic bluish green humeral blotch. Based on characteristic on recently described species the number of pelvic fin rays and unpaired fins coloration are autapomorphic for *P. bitteri*. We indeed preferred to assign the new species to *Papiliolebias* instead of creating a new genus, since we consider this choice more conservative.

Additionally to the above the genus *Papiliolebias* is characterized by: urohyal, dorsal process branched (also in some species of *Pituna*); third epibranchial, uncinat process, forming an angle of 45-60° with distal process (also in rivulines but not in plesiolebiasines); posttemporal, ventral process present; opercular region with regular reticulate pattern formed



Fig. 4. Type locality of *Papiliolebias francescae*: Rio San Pablo drainage, Rio Madeira River basin, Bolivia. Photo by S. Valdesalici.

by iridescent colour on middle of scales contrasting with dark orangish brown pigment along entire scale margins (also in *Pituna*); and humeral region with iridescent blotch (also in *Pituna*) (Costa 2011).

Osteologically *Papiliolebias francescae* differs from *P. bitteri* and *P. hatinne* by a triangular metapterygoid (vs. rectangular) (condition not known in *P. ashleyae*). This unique condition must be better investigated, because the two analyzed cleared and stained specimens were 19.1-20.1 mm SL, and perhaps the anterior vertical portion of this bone that gives its triangular shape in the remaining congeners might be present in large specimens. Additionally, *Papiliolebias francescae* differ from *P. bitteri* by possessing a reduced pattern of cephalic sensory canals.

As indicated in the Diagnosis, *Papiliolebias francescae* is readily distinguished from its congeners by several unique color pattern features. Additionally, *Papiliolebias francescae* can be diagnosed from its congeners by the number of caudal-fin rays (22-25 vs. 19-20 in *P. ashleyae*, 25-28 in *P. bitteri*, 20-23 in *P. hatinne*), fewer number of vertebrae (26 vs. 25-28 in *P. ashleyae*, 27-30 in *P. bitteri*, 26-28 in *P. hatinne*), more scales in transverse series (11-12 vs. 9 in *P. ashleyae*), and more anal-fin rays (18-19 vs. 15-16 in *P. ashleyae*, 17-18 in *P. bitteri*).

An additional, undescribed *Papiliolebias* species with pointed margin of dorsal and anal fin is known in the region around Trinidad in the Rio Mamoré drainage but its description is not the aim of the present work (see Hablützel, 2012 for details on this undescribed species).

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