

Description of a new annual fish, *Papiliolebias ashleyae* (Cyprinodontiformes: Rivulidae) from the upper Rio Mamoré basin, Bolivia

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Abstract

Papiliolebias ashleyae n. sp. is described from Bolivia, departamento de Santa Cruz, Rio San Pablo, upper Mamoré basin. *Papiliolebias ashleyae* n. sp. is distinguished from other *Papiliolebias* species by a combination of characters: male overall color pattern of body, caudal- and pelvic-fins brownish red (vs. dark blue); transverse brownish red bars in dorsal and anal fins located between black and white bar at base of dorsal and anal fins and blue area in distal part of dorsal and anal fins (vs. absence of red-brown stripe on the remaining species of the genus, where the color of dorsal and anal fins is blue with a black stripe and white spots at the base of the fins); dorsal-fin origin at vertical through base of anal fin rays 9th-10th (vs. dorsal fin origin at vertical through base of anal fin rays 7th-8th in *P. bitteri* and 6th-9th in *P. hatinne*) and pelvic fins separated by small interspace of 4 mm (vs. not separated).

Resumo

Papiliolebias ashleyae n. sp. é descrita da Bolívia, departamento de Santa Cruz, Rio San Pablo, alto bacía do Río Mamoré. *Papiliolebias ashleyae* n. sp. distingue-se das demais espécies de *Papiliolebias* pela seguinte combinação de características: padrão de cor no corpo dos machos, nas nadadeiras caudal e pélvica castanho avermelhado (vs. azul escuro); barras vermelhas transversais nas nadadeiras dorsal e anal, localizadas entre barras pretas e brancas na base da nadadeira dorsal e anal e área azul na área distal das nadadeiras dorsal e anal (vs. ausência de faixa de vermelho-marrom nas demais espécies do gênero onde a cor da nadadeira e dorsal e anal são azuis com uma faixa preta e manchas brancas à base das nadadeiras); nadadeira dorsal com origem na base do 9°-10° raio da nadadeira anal (vs. origem da nadadeira dorsal entre o 7°-8° raio da nadadeira anal em *P. bitteri* e 6°-9° em *P. hatinne*) e nadadeiras pélvicas separadas por pequeno espaço com 4 mm (vs. nadadeiras não separadas).

Zusammenfassung

Papiliolebias ashleyae n. sp. wird beschrieben aus Bolivien, Departamento Santa Cruz, Rio San Pablo, vom oberen Mamoré-Becken. *Papiliolebias ashleyae* n. sp. unterscheidet

sich von anderen *Papiliolebias*-Arten durch eine Kombination von Merkmalen: Farbe des Rumpfes insgesamt und auf den Schwanz- und Bauchflossen ein bräunliches Rot (statt Dunkelblau); bräunlich rote Querstreifen auf Rücken- und Afterflosse zwischen schwarzen und weißen Streifen an der Basis von Rücken- und Afterflosse und einer blauen Fläche im äußeren Bereich dieser Flossen (bei den anderen Arten der Gattung fehlen rötlich braune Streifen, dort sind Rücken- und Afterflosse blau mit schwarzen Streifen und weißen Flecken an der Basis); Ansatz der Rückenflosse senkrecht über der Basis des 9. bis 10. Afterflossenstrahls (im Gegensatz dazu befindet sich der Rückenflossenansatz bei *P. bitteri* über den Basen der 7. bis 8. Afterflossenstrahlen, bei *P. hatinne* über den Basen der 6. bis 9. Afterflossenstrahlen); und schließlich sind bei dieser neuen Art die Bauchflossen durch einen kleinen Zwischenraum von 4 mm getrennt (bei den anderen keine Trennung).

Résumé

Papiliolebias ashleyae n. sp. Est décrit, originaire de Bolivie, departamento de Santa Cruz, Rio San Pablo, bassin supérieur du Mamoré. *Papiliolebias ashleyi* n. sp. se distingue des autres espèces de *Papiliolebias* par une combinaison de caractéristiques: le patron de coloration du corps entier du mâle, la caudale et la pelvienne sont rouge-brun (au lieu de bleu foncé); la présence de barres transversales rouge-brun dans la dorsale et l'anale situées entre la barre noire et blanche à la base de la dorsale et de l'anale et d'une zone bleue dans la partie distale de la dorsale et de l'anale (contre l'absence d'une ligne rouge-brun pour le reste des espèces du genre où dorsale et anale sont bleues avec une ligne noire et des taches blanches à la base des nageoires); la naissance de la dorsale verticalement par la base des rayons 9 et 10 de l'anale (au lieu d'une naissance de la dorsale verticalement par la base des rayons 7 et 8 de l'anale pour *P. bitteri* et 6 et 9 pour *P. hatinne* et les pelviennes séparées par un petit espace de 4 mm (au lieu de non séparés).

Sommario

Papiliolebias ashleyae è una nuova specie descritta dalla Bolivia, Departamento de Santa Cruz, Rio San Pablo,

bacino Mamoré superiore. *Papiliolebias ashleyae* n. sp. si distingue dalle altre specie del genere *Papiliolebias* per una combinazione di caratteri: maschio colore generale del corpo, pinna caudale e pelvica rosso bruno (vs. blu scuro); barre trasversali rosse brunastre sulle pinne dorsali ed anale situate tra una barra bianca e nero alla base della dorsale e della anale e un'area blu nella parte distale delle pinne dorsale e anale (vs. assenza di striscia rossa-marrone sulle rimanenti specie del genere, dove il colore della dorsale e dell'anale è blu con una striscia nera e macchie bianche alla base delle pinne); origine della pinna dorsale sulla verticale passante tra il nono e il decimo raggio della pinna anale (vs. origine della dorsale tra il settimo e l'ottavo raggio in *P. bitteri* e sesto-nono raggio in *P. hatinne*) e pinne pelviche separate da piccola intercapedine di 4 mm (vs. non separate).

INTRODUCTION

Papiliolebias was originally erected by Costa (1998a) as a subgenus of *Plesiolebias*. Costa (2007) elevated *Papiliolebias* to the generic level. The genus *Papiliolebias* is a member of the tribe Plesiolebiasinae Costa (1998b, 2007), where it is included along with the genera *Pituna*, *Maratecoara*, *Plesiolebias*, and *Stenolebias*. All species of this tribe are found in the Amazon basin or the Rio Paraguay basin. The genus *Papiliolebias* can be distinguished from all other taxa of the Rivulidae by four synapomorphic conditions of the color pattern of males: unpaired fins dark blue, a white line along distal margin of anal fin, nine pelvic fin rays, and a metallic bluish green humeral blotch (Costa 1998b). Until recently, the only known species of the genus was *Papiliolebias bitteri* (Costa 1989). The original description of *Papiliolebias bitteri* was based on specimens from the aquarium trade, without precise information of the collection site. The only information then available was that the species was found in Paraguay (Costa 1989, Huber 1995). Huber (1995) provided a redescription of the species, where he listed seven localities for *P. bitteri* in the Chaco region of northwestern Paraguay and restricted its type locality to "64 km to the north from Mariscal Estigarriba, to Americo Picco, Paraguay" (c. 21°03'S, 60°30'W). In 2009, a second species of *Papiliolebias* was described, *Papiliolebias hatinne* Azpelicueta et al. (2009) from the Rio Bermejo basin, Provincia de Salta, Argentina.

The new species of *Papiliolebias* described herein was found for the first time in 2011 on the same road where the type-locality of *Spectrolebias brousseau* Nielsen 2013 is located. In 2012 sam-

ples were collected for the present descriptive work. The discovery of this new species in temporary pools at the upper the Rio Mamoré basin, Departamento Santa Cruz, Bolivia, extends the occurrence of the genus into the Amazon basin.

MATERIAL AND METHODS

Measurements were taken point-to-point under a stereomicroscope with a digital caliper to the nearest 0.1 mm on the left side of the specimens following Costa (1995; 2007). Measurements are expressed as percents of standard length (SL), with the exception the measurement of the head, which are recorded as percents of head length (HL).

In the description, counts of vertebrae and pleural ribs were taken from radiographs of the holotype, four males and four female paratypes. Terminology for frontal squamation follows Hoedeman (1958) and Costa (2006). Institutional abbreviations are UNITAU (Universidade de Taubaté, Brazil), MNKP (Museo Noel Kempff, Santa Cruz de La Sierra, Bolivia), and ZUEC (Museu de Zoologia da Universidade Estadual de Campinas, Brazil). Comparisons with congeners were made using the data and photographs provided by Costa (1989), Huber (1995), and Azpelicueta et al. (2009).

Papiliolebias ashleyae, n. sp. (Figs 1-2; Table I).

Holotype: MNKP-11203, male 34.7 mm SL: Bolivia, Departamento Santa Cruz, north of San José dos Chiquitos, Rio San Pablo, upper Rio Mamoré basin, 17°18'22.7"S 60°38'36.0"W, altitude 313 m, Didier Pillet, Jean Marc Beltramon, Bruno Accorsi, Michel Beuchey & Christine Lambert, 18 February 2012.

Paratypes: MNKP-11204, three males, 34.5-36.0 mm SL, two females, 27.1-29.0 mm SL; ZUEC 7297, one male, 34.6 mm SL, one female, 22.4 mm SL, collected with the holotype.

Diagnosis: *Papiliolebias ashleyae* differs from the remaining species of *Papiliolebias* by a lower pre-pelvic length in males (43.6-44.7% SL vs. 44.9-51.5% SL), a lower pre-pelvic length in females (43.3-46.8% SL vs. 48.2-51.7% SL), and by the color pattern of males which shows an overall red-brownish coloration, including the dorsal, caudal and pelvic fins basis (vs. overall color pattern dark blue, but never red-brown). It also presents a reddish-brown stripe on the basis of the dorsal and

anal fins, with whitish blotches, and distal portion of anal- and caudal-fins bluish (vs. absence of reddish-brown stripe in the remaining species of the genus, where the caudal and anal-fin basis possess white and black spots); dorsal-fin origin at vertical through base of anal-fin rays 9th-10th (vs. 7th-8th in *P. bitteri* and 6th-9th in *P. hatinne*); body with brownish-red background and iridescent greenish-blue scales, forming slender, oblique, ladder-like stripes (vs. oblique thick lines arranged parallel to each other); pelvic-fin red, with three spots (from basal to distal portion of fin): white, dark red and

white (vs. dark blue without spots); third pelvic fin-rays transformed into a filament (vs. third pelvic-fin ray not transformed into a filament), and pelvic-fin separated by a small 4 mm interspace (vs. not separated). Additional distinguishing features are provided in the Discussion.

Description: Morphometric and meristic data presented in Table I. Largest specimen examined 36.0 mm SL for males and 29.0 mm SL for females. Males larger than females. Body relatively deep, compressed, greatest body depth at level of pelvic-fin base. Snout blunt. Dorsal profile convex



Fig. 1. *Papiliolebias ashleyae*, male, holotype, 34.7 mm SL: Bolivia, San José dos Chiquitos (in life). Photo by D. Nielsen.



Fig. 2. *Papiliolebias ashleyae*, female, paratype, 29.0 mm SL: Bolivia, San José dos Chiquitos (in life). Photo by D. Nielsen.

Table I. Morphometric and meristic data for the holotype (H) and paratypes of *Papiliolebias ashleyae*.

	H	Paratypes	
	Male	Males n=4	Females n=3
Standard length (mm)	34.7	34.5-36.0	27.1-29.0
Percents of standard length			
Body depth	31.9	29.9-34.4	25.0-27.9
Caudal peduncle depth	15.6	14.2-16.3	12.5-14.0
Pre-dorsal length	62.5	60.5-62.7	64.3-68.2
Pre-pelvic length	44.9	43.6-44.7	43.3-46.8
Length of dorsal-fin base	18.4	18.4-20.2	12.4-14.2
Length of anal-fin base	30.8	30.8-33.6	22.4-22.8
Caudal-fin length	25.0	20.8-25.0	23.4-25.9
Pectoral-fin length	20.5	19.7-22.2	18.2-19.1
Pelvic-fin length	21.7	16.3-21.7	12.5-13.2
Head length	32.0	29.2-32.0	28.8-32.2
Percents of head length			
Head depth	91.9	87.0-92.5	75.1-77.3
Head width	62.8	61.6-63.0	67.4-70.3
Lower jaw length	17.8	15.3-17.7	14.2-15.2
Eye diameter	30.3	27.8-33.6	24.7-31.3
Counts			
Dorsal fin	11	11-12	10-11
Caudal fin	19	19-20	17-19
Anal fin	16	16-18	15-16
Pelvic fin	8	8	7
Pectoral fin	12	12-13	12
Meristics			
Scales in longitudinal series	25	25-26	26
Scales in transversal series	11	11	9
Horizontal scales around caudal peduncle	14	14	14

from snout to end of the dorsal fin base, slightly concave or straight on caudal peduncle. Ventral slightly profile convex from lower jaw to the end of the anal-fin base, nearly straight on caudal peduncle. Eyes positioned on upper portion of head side.

Tip of dorsal-fin slightly pointed in males, without filamentous rays; dorsal-fin in females rounded, without filaments; anal-fin rounded in males and females. Dorsal-fin origin at vertical through base of anal-fin rays 9th-10th. Caudal-fin rounded. Pectoral-fin rounded, its posterior margin reaching vertical between pelvic-fin base and urogenital papilla in males. Urogenital papilla slightly exposed, at vertical just posterior to pelvic-fin base in females. Pelvic-fin separated by small 4 mm interspace. Third unbranched pelvic-fin ray transformed into a filament. Tip of pelvic-fin

reaching base of anal-fin ray 8-10 in males, and between base of anal-fin rays 1-2 in females. Dorsal-fin rays 10-12, caudal-fin rays 17-20, anal-fin rays 15-18, pectoral-fin rays 12-13, and pelvic-fin rays 7-8.

Frontal squamation E-patterned. Longitudinal series of scales 25-26, transverse series of scales 9-11, scale rows around caudal peduncle 14. Total vertebrae 25-28. Anal-fin origin between neural spines of vertebrae 10 and 11 in males and females. Dorsal-fin origin between neural spines of vertebrae 15 and 17 in males, and neural spines of vertebrae 16 and 18 in females.

Color in life (Figs 1-2): Males: Sides of body red-brownish, with 7 to 9 iridescent greenish-blue, oblique, ladder-like stripes which can be incomplete or not. Metallic bluish green spot on humeral region. Dorsum and sides of head red, with dark spots, iris orange, dark vertical bar crossing the eye, and opercular region with golden spots. Black and white spots alternated along basal portion of dorsal and anal fins. Distal portions of dorsal and anal fins blue, with red stripe between blue area and basal, black and white area. Basal area of caudal fin red, distal portion of that fin blue. Pectoral-fin hyaline. Pelvic-fin red, with one dark red spot on base and one white spot at its middle portion. Distal margin of anal-fin with a white line.

Females: Body pale beige, without spots. Dorsal, caudal, pectoral and pelvic fins hyaline. Anal-fin pale yellowish. Iris pale orange, a black vertical bar crossing eye. Opercular region red and pale golden.

Distribution (Fig. 3): Only known from its type-locality, a pool just beside the highway between the cities San José dos Chiquitos and San Ignacio de Velasco, Rio Mamoré basin, Rio Madeira drainage, departamento de Santa Cruz, Bolivia.

Habitat (Fig. 4): The type-locality lies at the plateau area (313 m a.s.l.), just north of Llanos de Mojos, which occupy much of the Rio Mamoré basin in Bolivia (see Loubens et al., 1992). The temporary pool where the species was collected was about 250 meters in length for 20 meters of width, being situated right at the edge of the highway. Water depth at center of the pool was 120 cm. Water temperature at the surface of the pool was 34.5°C, while at the marginal area of the pool, at the depth of 20 cm, water temperature was 31°C (air temperature 32°C at the time of collecting). Specimens of *Papiliolebias ashleyae* were collected at the center of the pool. The pool presented turbid water, pH 6.9, 1 mg/l of dissolved iron (Fe) and

electric conductivity 47 $\mu\text{S}/\text{cm}$. Other fish species collected syntopically with *Papiliolebias ashleyae* were exclusively annual rivulid fishes: females of an unidentified *Neofundulus* species, *Spectrolebias brousseai* and an undescribed *Trigonectes* species. Other animals dwelling at the temporary pool were *Phylomedusa* sp. tadpoles, clams and freshwaters crabs. Aquatic vegetation was abundant and dense, with unidentified species belonging to the genera *Echinodorus*, *Utricularia* and *Nymphaea*.

Behavior in captivity: *Papiliolebias ashleyae* has a reproductive behavior similar to other species of the genus, which is also similar to the one found within the genus *Plesioblebias*, spawning without contacting the substratum. Males do not have an aggressive

behavior, when compared to other species of Rivulidae. The male attracts the female to its side by performing a rotation of 120° , around a point above the substrate. After this movement the couple stay positioned parallel, about 5 cm from the substrate. In this position a new rotation occurs, this time around the transverse axis of the female, during which 1-3 eggs are expelled and fertilized. The eggs are small, of about 0.90 mm of diameter and with long filaments at the surface of the chorium (similarly to the behavior and eggs described for *Plesioblebias xavantei* by Lacerda & Brazil 1988)

Etymology: In honor of the daughter of Dr. Roger Brousseau, Ashley Kimberly Brousseau, who collected the first specimen of the species.

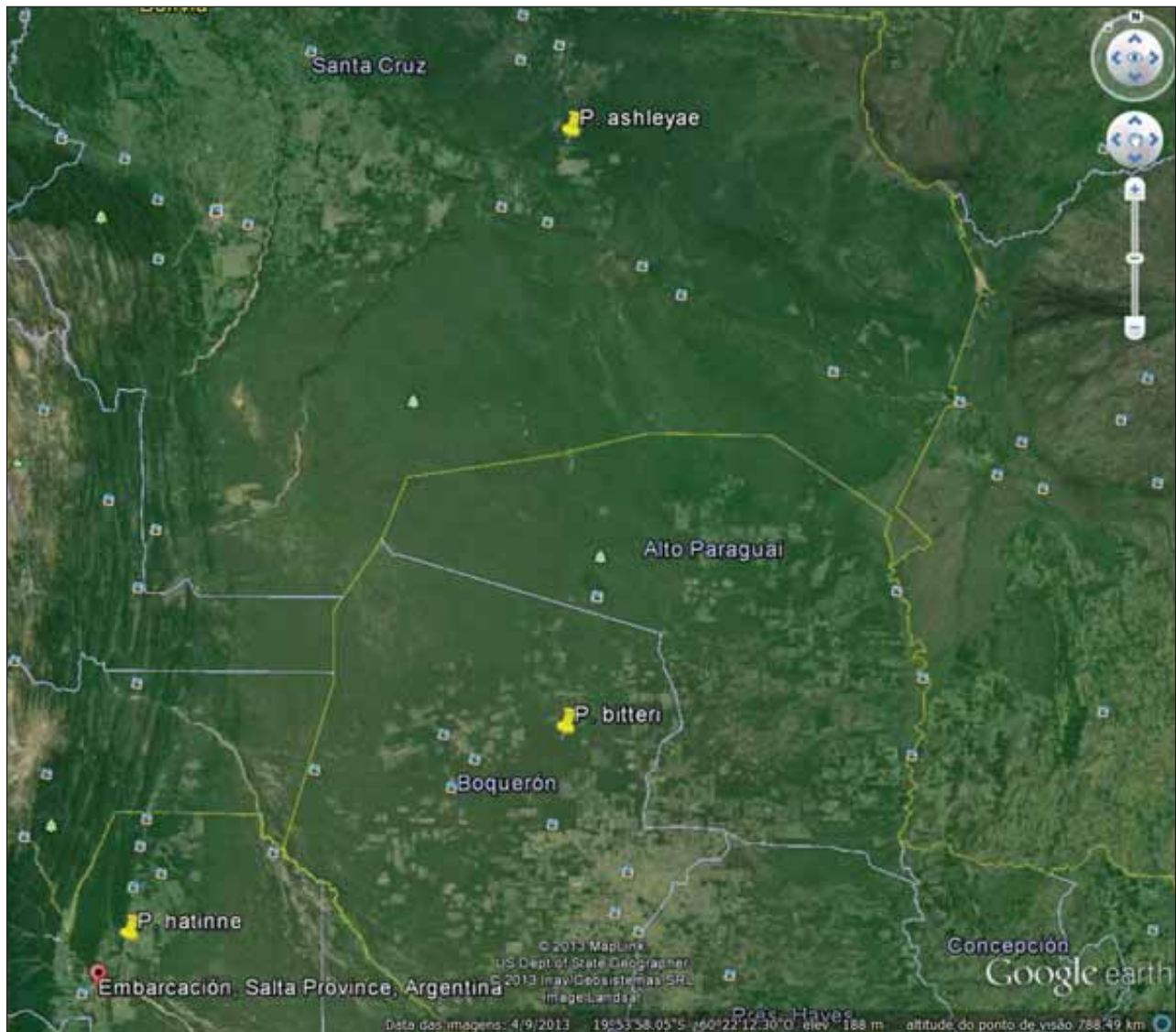


Fig. 3. Geographical distribution of the members of the genus *Papiliolebias*.

DISCUSSION

In addition to the characters mentioned in the Diagnosis, males of *Papiliolebias ashleyae* differ from males of *P. bitteri* by presenting a lower predorsal length (60.5-62.7% SL vs. 67.9-71.4% SL), fewer number of caudal-fin rays (19-20 vs. 25-28), lower number of pelvic-fin rays (8 vs. 9), and fewer number of pectoral-fin rays (12-13 vs. 14-15). Females of *Papiliolebias ashleyae* differ from females of *P. bitteri* by presenting a lower predorsal length (64.3-68.2% SL vs. 70.4-73.4), a lower anal-fin base length (22.4-22.8% SL vs. 23.9-27.3% SL), a lower head depth length (75.1-77.3% SL vs. 85.0-88.1% SL), and a lower eye diameter (24.7-31.3% HL vs. 35.2-37.5% SL). They can be additionally diagnosed from females of *Papiliolebias bitteri* by lacking dark dots on flanks (vs. presence of dark dots in the latter species). Males of *Papiliolebias ashleyae* differ from males of *Papiliolebias hatinne* by possessing a higher anal-fin base length (30.8-

33.6% SL vs. 26.6-29.6% SL), fewer number of caudal-fin rays (17-19 vs. 21-22), and fewer number of scales in transversal series (9 vs. 11). Females of *Papiliolebias ashleyae* differ from females of *P. hatinne* by presenting a lower head depth length (75.1-77.3% SL vs. 78.5-87.6% SL), a lower eye diameter (24.7-31.3% HL vs. 33.3-39.6% SL), fewer caudal-fin rays (17-19 vs. 20-23), and fewer anal-fin rays (15-16 vs. 17-18).

Papiliolebias was diagnosed by Costa (1998b) by the following four synapomorphies: nine pelvic-fin rays; unpaired fins dark blue; presence of white stripe along the distal margin of anal-fin and a humeral metallic green spot. Nine fin rays are present exclusively in *P. bitteri*; *P. hatinne* and *P. ashleyae* possess 7-8 rays, a feature considered plesiomorphic by Costa (1998a, b). The unpaired fins dark blue are only present in *P. bitteri*, as these fins are simply bluish in *P. hatinne* and blue in *P. ashleyae*. Therefore, nine pelvic-fin rays, and



Fig. 4. Type locality of *Papiliolebias ashleyae*: río San Pablo, upper Mamoré basin, Bolivia. Photo by D. Nielsen.

unpaired fins dark blue are actually autapomorphies of *P. bitteri*.

Papiliolebias ashleyae is easily distinguishable from its congeners by the color pattern of males, which shows an overall red-brownish coloration, including the dorsal, caudal and pelvic fins basis, which is absent in the remaining species of *Papiliolebias*, being the only species of the genus to present this overall color pattern.

A large humeral spot is always present in *Papiliolebias ashleyae*. In contrast, the humeral spot of *P. bitteri* and *P. hatinne* is smaller and even absent in some specimens. The presence of a humeral spot is relatively uncommon feature among rivulids, being present, among other taxa, in the closely related genus *Pituna* (Costa 1998b: 68). The absence of a humeral spot in closer outgroups to rivulids suggests that the presence of this spot is apomorphic for some rivulid taxa (Costa 1998b).

The Bolivian Amazon can now be considered to be a very rich area for annual fishes of the family Rivulidae. Several annual fish genera have been found in Bolivia with the presence of more than one species per genus (Nielsen 2013 a, b). Therefore it is possible that additional unknown species of *Papiliolebias* might occur at the Bolivian Amazon area.

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