

Spectrolebias pilleti, a new annual Killifish (Cyprinodontiformes: Rivulidae: Cynolebiatinae) from the upper río Mamoré basin, Bolivia

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Abstract

Spectrolebias pilleti n. sp. is described from a temporary pool from the upper río Mamoré basin, Departamento Santa Cruz, Quimone city, Bolivia. The new species is distinguished from all congeners by the unique color pattern of males: 3 to 5 vertical blue bars alternating with a light reddish brown background in males (vs. absence of bars), by the presence of an iridescent blue spot on the flank in female (vs. presence of one or more black spots), by the absence of filaments at the tips of dorsal fin and anal fin in males, except *Spectrolebias reticulatus* (vs. long filaments on dorsal and anal fins in *S. brousseui* and *S. filamentosus*, filaments on the dorsal fins of *S. semiocellatus* and *S. inaequipinnatus*, or filaments in the anal fins of *S. chacoensis*) and by the presence of scales covering the base of anal fin in males (vs. absence of these scales in the remaining congeners). Also distinguished from all congeners, with the exception of *S. reticulatus*, by the position of the dorsal fin, which has its origin anterior to the origin of the anal fin in males.

Resumo

Spectrolebias pilleti n. sp. é descrita de poças temporárias da bacia do alto rio Mamoré. Departamento de Santa Cruz, cidade de Quimone, Bolívia. A nova espécie se diferencia das demais espécies do gênero por possui padrão de coloração único nos machos: 3 à 5 barras verticais azuis alternadas com claras barras castanho no corpo dos machos (vs. ausência de barras) pela presença de uma mancha azul iridescente no flanco das fêmeas (vs. presença de uma ou mais manchas pretas), pela ausência de filamentos nas pontas das nadadeiras dorsal e anal (vs. longos filamentos nas nadadeiras dorsal e anal em *S. brousseui* e *S. filamentosus*, filamentos na ponta da nadadeira dorsal em *S. semiocellatus* e *S. inaequipinnatus* e filamentos na ponta da nadadeira anal em *S. chacoensis*) e presença de escamas cobrindo a base da nadadeira anal em machos (vs. ausência de escamas nas demais espécies do gênero). Também se distingue das demais espécies do gênero, exceto *S. reticulatus*, pela

posição da nadadeira dorsal, pois possui sua origem anterior a origem da nadadeira anal.

Zusammenfassung

Spectrolebias pilleti n. sp. wird von einem zeitweiligen Tümpel im Einzugsgebiet des oberen Mamoré, Departamento Santa Cruz, in der Stadt Quimone, Bolivien, beschrieben. Die Vertreter dieser neuen Art unterscheiden sich von allen anderen Angehörigen der Gattung durch das unverkennbare Farbmuster: 3 bis 5 senkrechte blaue Streifen, die sich von einem hell rötlich braunen Untergrund abheben bei den Männchen (bei den anderen Arten fehlen Streifen), schillernd blauer Fleck an der Seite bei den Weibchen (im Gegensatz zu einem oder mehreren schwarzen Flecken bei den anderen Arten), das Fehlen von fädigen Strukturen an den Spitzen von Rücken- und Afterflosse der Männchen, außer bei *Spectrolebias reticulatus* (*S. brousseui* und *S. filamentosus* haben lange Filamente an Rücken- und Afterflosse, *S. semiocellatus* und *S. inaequipinnatus* zeigen Filamente an der Rückenflosse, *S. chacoensis* an der Afterflosse) sowie Schuppen an der Basis der Afterflosse bei Männchen (die bei den anderen Arten der Gattung fehlen). Außerdem ist die Lage der Rückenflosse im Vergleich zu allen anderen Angehörigen der Gattung außer *S. reticulatus* ein Unterscheidungsmerkmal; sie setzt bei den männlichen Vertretern der neuen Art vor der Afterflosse an.

Résumé

Spectrolebias pilleti n. sp. est décrit en provenance d'une mare temporaire du bassin supérieur du río Mamoré, Departamento Santa Cruz Quimone city, Bolivie. La nouvelle espèce se distingue de tous ses congénères par la couleur unique des mâles: 3 à 5 barres verticales bleues alternant sur un fond légèrement rouge brun pour les mâles (contre l'absence de barres), par une tache bleue iridescente sur le flanc de la femelle (contre une ou plusieurs taches noires), par l'absence de filaments au bout de la dorsale et de l'anale pour le mâle, sauf pour *Spectrolebias reti-*

culatus (contre de longs filaments sur la dorsale et l'anale pour *S. brousseai* et *S. filamentosus*, des filaments sur les dorsales de *S. semicellatus* et *S. inaequipinnatus*, ou des filaments sur l'anale de *S. chacoensis*) et par des écailles couvrant la base de l'anale pour les mâles (contre l'absence des dites écailles chez les autres congénères). L'espèce se distingue aussi de tous les congénères, à l'exception de *S. reticulatus*, par la position de la dorsale, dont la naissance est antérieure à celle de l'anale pour les mâles.

Sommario

Spectrolebias pilleti n. sp. è descritto da una pozza temporanea dal bacino superiore del Rio Mamoré, Departamento Santa Cruz, Quimone, Bolivia. La nuova specie si distingue da tutte le congeneri per il colore unico della livrea maschile, caratterizzata da 3-5 barre blu verticali su un fondo marrone rossastro (vs. assenza di barre), dalla presenza negli individui femmina di una macchia blu iridescente sul fianco (vs. presenza di uno o più punti neri), per l'assenza di filamenti sulle punte sia della pinna dorsale sia della pinna anale nei maschi, tranne *Spectrolebias reticulatus* (vs. lunghi filamenti sulle pinne dorsale e anale in *S. brousseai* e *S. filamentosus*, filamenti sulle pinne dorsali in *S. semicellatus* e *S. inaequipinnatus*, o filamenti nelle pinne anali in *S. chacoensis*) e dalla presenza di scaglie che coprono la base della pinna anale nei maschi (vs. assenza di queste scale nei restanti congeneri). Si distingue anche da tutte le specie congeneri, con l'eccezione di *S. reticulatus*, per la posizione della pinna dorsale, la cui origine nei maschi è anteriore all'origine della pinna anale.

INTRODUCTION

The species of the genus *Spectrolebias* Costa and Nielsen, 1997 is distributed across the tributaries of the right margin of Amazon River, with a single exception, *Spectrolebias chacoensis* which is found in the río Paraguay basin. Currently, the following species are: *S. chacoensis* (Amato, 1986), from the río Paraguay basin, Paraguay and Argentina; *S. costai* (Lazara, 1991) from the rio Araguaia and rio Tocantins basins, Brazil; *S. semicellatus* Costa & Nielsen, 1997, from the rio Araguaia basin, Brazil; *S. filamentosus* (Costa, Barreira & Sarmiento, 1997), from the rio Madeira basin, Bolivia; *S. reticulatus* (Costa & Nielsen, 2003), from the rio Xingu basin, Brazil; *S. inaequipinnatus* (Costa & Brasil, 2008), from the rio Tocantins basin, Brazil, and *S. brousseai* Nielsen, 2013, from the río Mamoré basin, Bolivia.

Spectrolebias was originally considered a genus (Costa & Nielsen, 1997). After a phylogenetic analysis made by Costa (2006), was considered one of the five subgenera of *Simpsonichthys*, but latter, Costa (2010) promoted it back to a genus status.

According to Costa (2006) *Spectrolebias* is distinguished from all other cynolebiasins by two unambiguous synapomorphies: a long (vs. short) hyomandibula and a narrowed (vs. wide) proximal tip of the fourth ceratobranchial.

All species of the genus *Spectrolebias* are annual fish and live in temporary water pools where they lay eggs by diving into the substrate. As the remaining representatives of the tribe Cynolebiasini, species of the genus *Spectrolebias* possess an annual life cycle. At the end of the rainy season the pool dries and all fish die, but their eggs survive and develop throughout the dry season in the substratum. As soon as the rain starts, the pools fill up with water and the eggs hatch, starting a new generation that will on his turn grow, breed and keep the cycle going (Myers, 1952; Costa, 1995; Nielsen, 2008).

The present contribution describes an additional species of *Spectrolebias* from Bolivia, the third species known for the country. This new species was found in the basin of the rio San Pablo, a tributary on the right side of the río Mamoré, Quimone city, Departamento de Santa Cruz. It was original discovered in 2011, at the same location of the specimens collected in 2012, which served as the basis for this work.

MATERIAL AND METHODS

Measurements were taken point-to-point under a stereomicroscope with a digital caliper to the nearest 0.1mm, on the left side of the specimens, whenever possible, following Costa (1995, 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 radiographs of the holotype and two female paratypes. Terminology for frontal squamation follows Hoedeman (1958) and Costa (2006). For vertebral counts the caudal compound centrum was counted as a single element. Osteological features included in the description are those considered phylogenetically informative by recent studies on *Spectrolebias* (Costa 2006, 2007, 2010). Institutional abbreviations follow Sabaj-Pérez (2010), with addition of UNITAU (Universidade de Taubaté) and MNKP- Museo Noel Kempff. Comparative material of other rivulids examined in the present study is listed in Costa (2007).

***Spectrolebias pilleti*, n. sp.**

(Figs 1-2, Table I)

Holotype: Deposited at Museo Noel Kempff, Santa Cruz de La Sierra, Bolivia. (MNKP-11153) male 28.9 mm SL: Bolivia, Departamento Santa Cruz, Quimone city, 45.40 km west of San José dos Chiquitos, temporary pool near the río Quimone, the río San Pablo basin, (17°42'48.1"S 61°08'56.1"W), altitude 263 m, 26 February 2012, Didier Pillet, Jean Marc Beltramon, Michel Beuchey & Christine Lambert.

Paratypes: Deposited at Museo Noel Kempff, Santa Cruz de La Sierra, Bolivia (MNKP-11154) five male and eight females (24.3-30.0 mm SL), collected with the holotype. Deposited at Universidade de Campinas, Campinas, São Paulo, Brazil. (ZUEC 7296), one male (36.0 mm SL), two females (22.5-26.0 mm SL), collected with the holotype.

Diagnosis: The new species differs from the remaining representatives of the genus *Spectrolebias* by the unique color pattern of males: 3 to 5 vertical blue bars alternating within a light reddish brown background in males (vs. absence of bars), by the presence of a iridescent blue spot on the flanks of the females (vs. presence of one or more black spots in females) and by the presence of scales

covering the basis of anal fin in males (vs. absence of scales covering the basis of the anal fin in the remaining congeners). Distinguished from all congeners, except *S. reticulatus*, by the position of the dorsal fin, which has its origin anterior to the origin of the anal fin in males, and by possessing the tips of both dorsal and anal-fins pointed in males, without elongated rays (vs. tips of both dorsal and anal-fins pointed in males, with elongated rays, in the remaining congeners).

Description: Morphometric data presented in Table I. Largest specimen examined 30.0 mm SL. Dorsal profile slightly concave on head, convex from nape to end of dorsal-fin base, approximately straight along caudal peduncle. Ventral profile slightly convex from tip of jaw to origin of caudal peduncle and slightly concave from latter point to uppermost procurent caudal-fin rays. Body moderately deep, compressed, greatest body depth on vertical slightly ahead to anal-fin origin. Eye positioned on lateral portion of side of head. Snout blunt. Large number of labial papillae in males. Urogenital papilla cylindrical and long in males, pocket-shaped in females. Tip of both dorsal and anal-fins pointed in males without elongated rays; dorsal fin in females rounded to slightly pointed without filaments; anal-fin rounded in females. Dorsal-fin rays unbranched. Caudal-fin rounded.



Fig. 1. *Spectrolebias pilleti*, male, holotype, 28.9mm SL. MNKP-11153. Photo by G. Dethu.

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

	H	Paratypes	
	Male	Male n = 6	Females n = 8
Standard length (mm)	28.9	27.6-30.0	22.2-24.3
Percents of standard length			
Body depth	34.1	33.8-36.1	31.7-35.6
Caudal peduncle depth	11.2	12.7-14.0	11.5-13.5
Pre-dorsal length	45.8	43.9-44.6	50.2-59.7
Pre-pelvic length	42.4	39.5-42.4	43.7-50.1
Length of dorsal-fin base	38.9	34.1-39.3	21.1-24.5
Length of anal-fin base	39.2	35.1-40.8	23.1-27.4
Caudal-fin length	26.8	25.0-28.4	22.2-27.1
Pectoral-fin length	29.7	28.2-34.2	18.9-26.4
Pelvic-fin length	10.9	9.5-13.7	8.5-11.2
Head length	29.7	28.7-30.6	28.6-31.5
Percents of head length			
Head depth	86.3	86.1-95.3	92.2-98.6
Head width	40.9	38.5-43.2	42.6-48.5
Snout length	6.9	6.8-7.2	14.3-14.8
Lower jaw length	11.6	11.6-13.2	14.1-15.7
Eye diameter	34.4	28.7-34.4	27.5-32.8
Counts			
Dorsal fin	23	23-24	20-21
Caudal fin	22	20-22	19-21
Anal fin	24	22-24	21-22
Pelvic fin	5	5	5
Pectoral fin	11	10-11	8-9
Scales in longitudinal series	28	29	
Scales in transversal series	12	9	
Horizontal scales around caudal peduncle		10	16



Fig. 2. *Spectrolebias pilleti*, female, paratype, 24.3 mm SL. MNKP-11154. Photo by G. Dethu.

Dorsal-fin origin on vertical anterior to anal-fin origin in males, anal-fin origin on vertical between base of 1st and 3th dorsal-fin rays; dorsal-fin origin on vertical through base of 2nd anal-fin rays in females. Tip of each pelvic-fin reaching base of 8rd to 9th anal-fin rays in males, and base of 1st to 2nd anal-fin rays in females. Dorsal-fin origin between neural spines of fifth and sixth vertebrae in males, and between neural spines of tenth and eleventh vertebrae in females. Anal-fin origin at twelfth pleural ribs of vertebrae in males, and pleural ribs of vertebrae ninth in females.

Dorsal-fin rays 19-20 in males, 20-21 in females, anal-fin rays 22-24 in males, 21-22 in females, caudal-fin rays 20-21, pectoral-fin rays 10-11 and pelvic fin-rays 5. Frontal squamation E-patterned; E-scales overlapping medially; no scale anterior to G-scale; supraorbital scales absent. Longitudinal series of scales 27-28; transverse series of scales 12-13; scale rows around caudal peduncle 9-10. Contact organ absent on flanks and pectoral fins in males.

Coloration in life (Figs. 1-2):

Males: Head and trunk to the vertical line passing through pelvic-fin origin light brown. Posterior two-thirds of body with three to five blue bars, over the light-brown background, including the unpaired fins. Light blue spots sparsely distributed across the caudal peduncle. Color pattern can be assymetrical; a single male can have three vertical blue bars in one side of the body and five bars in the other side.

Tip of jaw darkened. Dorsal and anal-fins blue, with irregularly-distributed small light blue spots. Caudal-fin blue with higher concentration of light blue spots than dorsal and anal fins. Hyaline pectoral fin. Pelvic-fin blue without light blue spots. Black bar vertically crossing the eye.

Females: Side of body light brown, with 6-8 light-gray bars; one blue iridescent single spots on mid-body. Scattered iridescent blue scales present in gray bars. Sides of head light brown, opercular region pale greenish golden. Iris light yellow, with dark vertical brown bar across center of eye. Fins hyaline.



Fig. 3. Type locality of *Spectrolebias pilleti* near of Quimone city, Departamento de Santa Cruz, Bolivia. Photo by D. Nielsen.

Distribution (Fig. 3): Only known from the type-locality, a pool near of the río Quimone, tributary of the río San Pablo, tributary of the río Mamoré, Departamento Santa Cruz, Quimone city, Bolivia.

Habitat (Fig. 4): The type-locality lies at the plateau area (263 m.a.s.l.), at the border of the Llanos de Chiquitos, to the north of the Bañados del Izozog, where several rivers of the upper río Mamoré basin drain, eastern Bolivia (see Loubens et al., 1992). The annual pool is very large, with most of its area within a dense, difficult to access forest. The temperature on the water surface was 28°C and, in the deepest portion and banks. Average depth of the pool is 40 cm, with deepest por-

tions about 60 cm. In the marginal area of the pool, at the depth of 10 cm, water temperature was 31°C. Specimens of *Spectrolebias pilleti* were collected in depths no shallower than 20 cm depth. The pool presented clean water, pH 6.8, dissolved iron (Fe) 0,25 mg/l and electric conductivity 100 μ S. Other fish species collected syntopically were exclusively annual fishes: *Spectrolebias brousseaui*, *Neofundulus* sp., and *Papiliolebias* sp. Other animals recorded were *Phylomedusa* sp. tadpoles, clams and freshwaters crabs. The aquatic vegetation was very dense, composed by *Echinodorus* sp., *Utricularia* sp. and *Nymphaea* sp.

Etymology: The specific name is in honor of

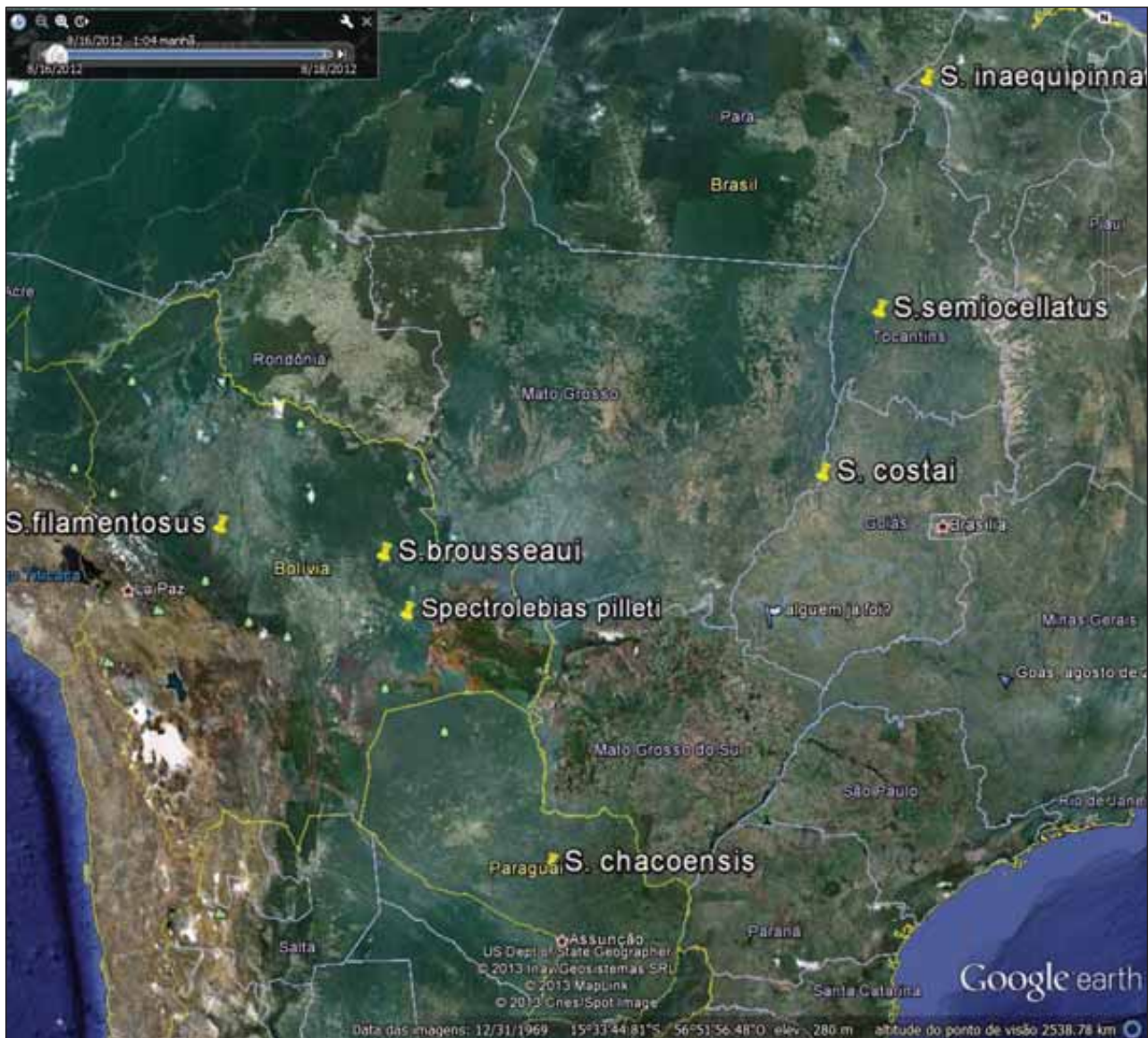


Fig. 4. Geographic distribution of members *Spectrolebias*. Photo by D. Nielsen

environmentalist Didier Pillet, one of the collectors of the new species.

DISCUSSION

Albeit being still little explored, field exploration during the last few years in Bolivia has revealed a large number of annual species, besides *Spectrolebias*, annual fishes from the genera *Papiliolebias*, *Trigonectes*, *Neofundulus*, *Moema*, *Aphyolebias*, and *Pterolebias* (Costa 1996, 1998, Costa, Barrera, & Sarmiento 1997), were recorded for the country, though most of these records are still unpublished (see Nielsen, 2013). There are also non annual Rivulidae species, from the genera *Cynodontichthys* and *Anablepsoides*. Such high diversity is probably a result of a combination of factors, i.e., favorable geography, vegetation, and high river drainage density and high precipitations level across this region, all favorable to the maintenance dispersion of annual fishes. The possibility of finding new species in this region was raised in Nielsen 2013. The discovery of *S. pilleti* reinforces this idea.

Males of *Spectrolebias pilleti* differ from *S. brousseai* by the absence of dark blue coloration and bright blue spots aligned along the body of males (vs. presence), by the smaller size of bright blue spots on unpaired fins (vs. larger spots, half the diameter of the pupil), by having pelvic-fin bases in contact (vs. pelvic-fin bases separated by interspace), pelvic-fin dark blue lacking spots (vs. presence of iridescent blue spots in the center), absence of contact organs on flank scales in males (vs. presence), tip of pelvic-fin reaching the 8th or 9th anal-fin ray (vs. 3rd to 5th), lower predorsal length (43.9-44.6% SL vs. 47.2-51.5%), lower caudal-fin length (25.0-28.4% SL vs. 29.6-32.6%), longer pectoral-fin length (28.2-34.2% SL vs. 21.1-22.9%), lower head width (38.5-43.2% HL vs. 54.6-55.6%), greater number of dorsal-fin rays (23-24 vs. 21-22), fewer number of pectoral fin (10-11 vs. 12), greater number of scales in transverse series (12-13 vs. 8-9), and fewer number of horizontal scales around caudal peduncle (9-10 vs. 14-16).

Females of *S. pilleti* differ from females of *S. brousseai* by a longer head depth (92.2-98.6% HL vs. 78.1-91.6), lower head width (42.6-48.5% HL vs. 53.0-59.6), lower snout length (14.3-14.8% HL vs. 18.7-23.4), greater number of dorsal-fin rays (20 vs. 15-16), fewer number of pectoral fin-rays (8-9 vs. 10-11), and greater number of scales in transverse series (12-13 vs. 10).

The limited amount of research along with the difficulty of accessing this area (primarily due to the small number of roads in the region), raises the possibility that many other annual fish species could be found in the Bolivian part of the Amazon basin. Members of the *Spectrolebias* genus are currently found in the Araguaia, Tocantins e Xingu basins in Brazil and in the río Mamoré basin in Bolivia. Additionally, between those river basins (all major southern tributaries of the Amazon River) are the río Guaporé and río Tapajós, and it is plausible that *Spectrolebias* species might occur in these intervening river basins.

The color pattern of the body, with the alternated blue and reddish brown bars, the absence of filaments at the tip of anal and dorsal fins, and the small iridescent blue single spots present in females body are autapomorphies of *Spectrolebias pilleti* within the genus *Spectrolebias*. All three species of *Spectrolebias* occurring in Bolivia (*S. pilleti*, *S. filamentosus*, and *S. brousseai*) can be found in the río San Pablo basin, a tributary of the río Mamoré, suggesting that additional species of *Spectrolebias* can be expected to occur in the río Mamoré basin given its large area, little coverage by field research and difficult access.

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