

Rivulus gaucheri, a new species of rivuline (Cyprinodontiformes: Rivulidae) from French Guiana

by

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ABSTRACT. - *Rivulus gaucheri*, new species, is described on the basis of 11 specimens collected from small tributaries of the Litany river basin in the southwest highlands of French Guiana. *R. gaucheri* differs from all other congeners by the lack of the supracaudal spot at all ages in both sexes, a short base of dorsal fin, a yellow colour background of the body, a red colored sub-distal area on the anal fin in male, and a yellow one in female, and a dark margin of caudal fin.

RÉSUMÉ. - *Rivulus gaucheri*, une nouvelle espèce de rivuline (Cyprinodontiformes : Rivulidae) de Guyane française.

Rivulus gaucheri, nouvelle espèce, est décrite à partir de 11 spécimens collectés dans des petits affluents du bassin de la rivière Litany, dans le sud-ouest montagneux de Guyane française. *R. gaucheri* diffère des autres espèces par l'absence de l'ocelle supracaudal à tous les âges et quel que soit le sexe, une nageoire dorsale à base courte, une coloration jaunâtre dominante du corps, une marge rouge sur la nageoire anale du mâle, une marge jaune sur celle de la femelle, et une marge noire sur la nageoire caudale.

Key words. - Rivulidae - *Rivulus gaucheri* - French Guiana - Freshwater - New species.

Many ichthyological inventories took place in French Guiana since Puyo (1949), which quoted 74 species (Keith, 1997). The first systematic inventories started in 1958 with the French Institute of Tropical America (IFAT), then in 1962 with the King of the Belgians, Léopold III, and J.P. Gosse, who carried out long prospections on Oyapock River. Stopped during nearly twenty years, the inventories were started again in 1976 on Oyapock by d'Aubenton from Muséum national d'Histoire naturelle (MNHN) and G. Vidy from ORSTOM, and then in 1978 on the whole of the Guianese rivers by the National Institute of the Agronomic Research (INRA) (Keith, 1997). From 1992, the MNHN of Paris and the INRA initiated the realization of an atlas in order to establish a state of reference on the geographical distribution of freshwater fishes of French Guiana (Planquette *et al.*, 1996; Boujard *et al.*, 1997; Le Bail *et al.*, 2000; Keith *et al.*, 2000). To realize it, many inventories were made on the whole Guianese basins and 480 species are now known in this area (Keith *et al.*, 2000). Among those, 8 species of Rivulidae were quoted (Le Bail *et al.*, 2000).

Nevertheless, in spite of these prospections, the mountainous areas of the south of French Guiana have not been prospected. In 2001, an expedition was organized by the National Parc Project (NPP) in the southwest border, near the Mont Mitaraka (Fig. 1). During this survey, further specimens of a new species of *Rivulus* sensu Costa (1995b) were

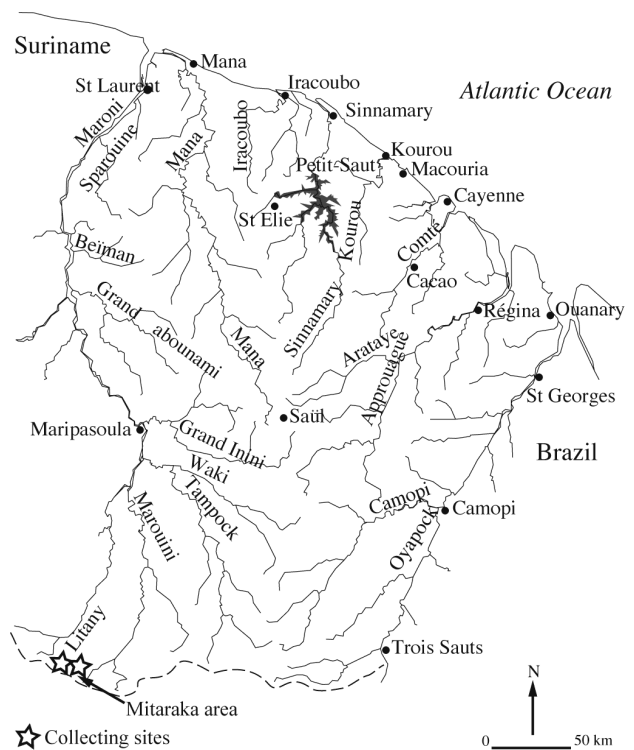


Figure 1. - Distribution area of *Rivulus gaucheri*. [Distribution géographique de *Rivulus gaucheri*].

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found. This area was visited during a second expedition in 2002 and additional specimens were collected.

Few species of Rivulidae are known in the highlands of the Guiana shield. One is described from Surinam (*R. amphoreus* Hubert, 1979), two from British Guiana (*R. waimacui* Eigenmann, 1909 and *R. torrenticola* Vermeulen & Isbrücker, 2000), and one from Venezuela (*R. immaculatus* Thomerson, Nico & Taphorn, 1991).

The aim of the paper is to describe the new species from French Guiana.

MATERIALS AND METHODS

Measurements and counts follow Costa (1995a). Measurements were taken with a dial caliper to the nearest tenth of a millimetre. All counts were taken from the right side. Measurements are presented as percentage of standard length (SL), except for parts of head length (HL). Counts of pectoral and caudal fins rays were made with dissecting microscope with light transmitted through the fins and confirmed with radiographs. Vertebrae counts are made from radiographs. Nomenclature for frontal squamation patterns follows Hoedeman (1958). Abbreviations for institutions and collections follow Leviton *et al.* (1985). Some aspects of meristics and morphometrics are summarized in tables I and II.

Comparative material

Rivulus amphoreus Hubert, 1979. - Holotype: MNHN 1979-0286, 65 mm SL, Surinam. - Paratypes: MNHN 1979-0287, 2 specimens (57-58 mm SL), Tafelberg, Surinam.

Rivulus igneus Hubert, 1991. - Holotype: MNHN 1989-1643 (69 mm SL), montagne des Singes, French Guiana. - Paratypes: MNHN 1979-0647, 31 spms (14-78 mm SL); St. Elie, crique Tigre, French Guiana. - MNHN 1981-0241, 1 spm (68 mm SL), Oyapock, crique Wilili, French Guiana. - MNHN 2001-0427, 4 spms, Sinnamary, French Guiana. - MNHN 2001-2067, 1 spm, Mana, French Guiana.

Rivulus lungi Berkenkamp, 1984. - MNHN 1992-0129, 9 specimens, Kourou, French Guiana. - MNHN 1992-0130, 5 spms, Approuague, Arataye, French Guiana. - MNHN 1992-0131, 1 spm, Kourou, French Guiana. - MNHN 1986-0258, 4 spms, Matoury, French Guiana. - MNHN 2000-6355, 2 spms, nivrée 2000, Tappock, French Guiana.

Rivulus urophthalmus (Günther, 1866). - MNHN 1991-0368, 5 spms, Sao Luis, Brazil. - MNHN 1991-0372, 2 spms, Rio do Para, Brazil.

Kryptolebias sepia Vermeulen & Hrbek, 2005. - MNHN 2004-3096, 1 spm, Tapanahony River, Surinam.

Comparative datas from *R. torrenticola* Vermeulen & Isbrücker, 2000 are taken from Vermeulen and Isbrücker (2000), *R. holmiae* and *R. waimacui* Eigenmann, 1909 from Eigenmann (1909), *R. immaculatus* Thomerson, Nico & Taphorn, 1991, from Thomerson *et al.* (1991) and *R. hartii* (Boulenger, 1890) from Hubert (1992).

RIVULUS GAUCHERI, N. SP.

(Fig. 2; Tabs I-II)

Material examined

Eleven specimens from tributaries of Litany, French Guiana with a size range of 26.4-57.1 mm SL.

Holotype. - MNHN 2005-0171, female (50.7 mm SL), Mitaraka, marshes in Alama River (Litany basin), French Guiana, 02°17.295 N-54°32.665 W (altitude: 339 m high), 19 Oct. 2002, Coll. P. Keith & P. Gaucher.

Paratypes. - MNHN 2002-0202, female (49.4 mm SL), Mitaraka, marshes in Alama basin (Litany basin), French Guiana (altitude: near 250 m high), 10 Mar. 2001, Coll. P. Gaucher. - MNHN 2002-3540, 7 spms (2 males, 5 females), size range 31.9-57.1 mm SL, same datas as holotype. - MNHN 2002-0084, 2 spms (juveniles), size range 26.4-31.6 mm SL, Mitaraka, marshes in Alama basin (Litany basin), French Guiana (altitude: near 250 m high), 10 Mar. 2001, Coll. P. Gaucher.

Non-types. - MNHN 2005-3559, 5 spms, same datas as holotype. One of them cleared and stained.

Diagnosis

Rivulus gaucheri is distinguished from other congeners by a combination of characters including dorsal and anal fin rays counts, number of scales in lateral and transverse series, by the lack of the supracaudal spot at all ages in both sexes, a short base dorsal fin, a yellow colour background on body, a red coloured sub-distal area on anal fin in male, with a yellow one in female, and a dark margin on caudal fin.

Description

The new species presents a developed anterodorsal process of urohyal, a shortened uncinat process of third epibranchial, a rostral cartilage with posterior narrowing abrupt, yielding a distinctive narrow portion, characteristic



Figure 2. - *Rivulus gaucheri* MNHN 2002-3540, female, Photo P. Keith.

Table I. - Morphometrics of *Rivulus gaucheri*. [Morphométrie de *Rivulus gaucheri*].

Status	Holotype		Paratypes									
	Register # (MNH)	2005-0171	2002-0202	2002-3540						2005-0084		
Number				N°1	N°2	N°3	N°4	N°5	N°6	N°7	N°1	N°2
Sex	F	F	F	F	F	F	M	F	M	F	juv	juv
Standard length [mm]	50.7	49.4	57.1	39.3	40	32	41.7	31.9	40.5	31.6	26.4	
	% of SL	% of SL	% of SL	% of SL	% of SL	% of SL	% of SL	% of SL	% of SL	% of SL	% of SL	% of SL
Total length	117.6	121.6	119.4	115.3	117.6	109.4	117.3	120.1	119.9	114.0	119.7	
Standard length	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
Body depth	18.2	20.1	17.2	17.2	17.4	17.7	17.5	17.0	18.1	15.3	18.6	
Predorsal length	72.5	74.8	74.7	70.4	70.7	71.0	70.9	73.7	72.1	70.3	71.2	
Prepelvic length	48.3	49.9	49.0	47.6	49.4	46.0	48.0	48.3	50.0	47.0	49.2	
Length of dorsal fin base	7.9	7.8	7.3	7.6	5.8	6.1	6.9	6.0	8.3	8.3	/	
Length of anal fin base	17.6	19.6	17.4	20.8	17.1	19.1	18.6	18.1	19.1	20.6	13.4	
Caudal fin length	19.9	21.9	19.1	18.3	17.9	24.3	21.0	20.1	22.1	17.5	19.7	
Pectoral fin length	17.4	16.2	17.8	18.7	18.0	17.0	17.7	18.5	19.0	15.2	17.4	
Pelvic fin length	8.7	7.7	9.2	7.6	7.2	8.7	8.6	7.8	9.1	7.5	7.0	
Head length	24.6	24.8	24.7	24.9	25.0	26.4	24.9	26.0	24.9	23.1	25.6	
Head depth	16.1	16.4	15.8	15.1	15.1	15.0	14.9	15.0	14.7	13.1	17.0	
Head width	17.0	18.9	17.6	16.4	16.4	17.3	17.0	16.9	17.9	13.9	17.4	
Preanal length	58.5	60.5	59.8	56.6	60.5	58.1	59.5	59.2	60.4	58.1	54.9	
	% of HL	% of HL	% of HL	% of HL	% of HL	% of HL	% of HL	% of HL	% of HL	% of HL	% of HL	% of HL
Snout length	42.8	41.6	42.9	40.6	43.0	42.0	43.3	45.8	46.0	47.3	44.0	
Lower jaw length	34.9	37.3	36.7	35.3	34.8	31.5	34.2	34.0	35.0	36.8	27.0	
Eye diameter	26.7	27.2	24.8	26.1	23.7	26.6	25.7	26.6	24.8	23.3	25.6	

of the genus *Rivulus* in the opposite of *Kryptolebias* sensu Costa (1995b).

Dorsal profile slightly strait. Body slender, cylindrical. Body depth slightly greater than body width. Jaws short (27-37.3% of HL), snout blunt. Teeth sharp, monocuspid and recurved. Tip of dorsal and anal fins slightly pointed in males, rounded in females. Caudal fin elliptical. Pectoral fin elliptical, its posterior margin not extending to vertical anterior to pelvic fin base. Pelvic fin short (7-9.2% SL) with tip reaching base of anus. Dorsal fin base short (7.3-8.3% of SL) with its origin between base of 9th-10th anal fin rays. Dorsal fin rays 8-9, anal fin rays 13-15, pelvic fin rays 6-8, pectoral fins rays 13-14.

Scales cycloid. Body and head entirely scaled. Body squamation extending slightly onto caudal fin base. Longitudinal series of scales 38-41, transverse series of scales 10-11, scale rows around caudal peduncle 18-20.

Frontal squamation E-patterned, without any variation in difference as the genus *Kryptolebias*. Frontal neuromasts with open type for the anterior pair, three pairs in two parallel series for the supraorbital series, separated in two regions, one single anterior neuromast and one posterior pair with no channel in-between. Preopercular neuromasts are with one vertical pair in an open channel. Total vertebrae 31-35.

The new species is closer to the *hartii* superspecies as proposed by Huber (1992) by general morphology and pat-

tern. This group includes *R. torrenticola* Vermeulen & Isbrücker, 2000, *R. holmiae* Eigenmann, 1909, *R. waimacui* Eigenmann, 1909, *R. immaculatus* Thomerson, Nico & Taphorn, 1991, *R. igneus* Huber, 1991 and *R. hartii* (Boulenger, 1890). The new species is also close from *R. urophthalmus* and *R. lungi* by some meristic characters.

Colour in life

A supracaudal spot is lacking in this species at all ages in both sexes.

Male: head yellowish brown with irregular dark brown spots. Sides yellowish with the presence of a punctuation forming some longitudinal lines. Belly whitish to creamy. Anal fin with numerous brown spots and with a red coloured subdistal area. Dorsal and caudal fins pinkish with numerous brown spots. Caudal fin with a red superior margin and a more dark inferior one. Pelvic and pectoral fins hyaline. A dark opercular blotch on head made with irregular markings and forming 2-5 longitudinal lines. Numerous vertical irregular brownish bars on sides.

Female (Fig. 2): The sexual dichromatism is little developed. Pattern similar to male, except anal fin with a yellow coloured subdistal area and caudal fin yellowish with numerous brown spots.

The conservation of ten individuals in aquaria during 3 years has not shown any variation in coloration in males, females or juveniles.

Table II. - Meristics of *Rivulus gaucheri*. [Méristique de *Rivulus gaucheri*].

Status	Holotype		Paratypes									
	Register # (MNHN)	2005-0171	2002-0202		2002-3540						2005-0084	
Number			N°1	N°2	N°3	N°4	N°5	N°6	N°7	N°1	N°2	
Sex	F	F	F	F	F	M	F	M	F	Juv	Juv	
Number of vertebrae	35 16+19	35 16+19	35 16+19	34 15+19	35 16+19	34 15+19	35 16+19	35 16+19	34 15+19	34 16+19	31 16+15	
Number of dorsal fin rays	8	8	8	8	8	9	8	8	8	8	8	
Number of anal fin rays	15	15	14	14	14	14	15	14	14	13	13	
Number of pectoral fin rays	13	13	13	14	14	14	14	13	14	14	14	
Number of pelvic fin rays	8	8	7	8	7	6	8	6	6	7	6 9	
Longitudinal series of scales	40	39	40	39	41	40	40	38	40	40		
D/A	9	9	9	9	9	9	8	8	9	9		
Transverse series of scales	10	10	10	10	10	10	10	10	11	10	10	

Colour in preservation

Male: general pattern similar but more fade than in live. Head and dorsum of body brown to grey with irregular dark brown spots. Sides brownish to greyish, belly whitish to creamy. Anal and caudal fins with a dark coloured subdistal margin. Dorsal, anal and caudal fins with numerous brown spots.

Female: similar to male.

Habitat and ecology

Rivulus gaucheri was found in small groups in small mountainous rivers and marshes. The specimens of March 2001 were caught with hand net in a small forest stream between North Mitaraka and South Mitaraka. The stream was 2-3 m wide and 60 cm deep. *R. gaucheri* were caught along with *Erythrinus erythrinus* (Schneider, 1801). The specimens of October 2002 were caught with hand net in small pools and marshes, along a little forest river. The water was clear, shallow (10-20 cm deep), with some leaves and vegetation at the bottom. They were caught along with two Lebiasinidae, *Copella carsevevnnensis* (Regan, 1912) and *C. arnoldi* (Regan, 1912), two Characidae, *Bryconamericus* aff. *stramineus* Eigenmann, 1909 and *Moenkhausia oligolepis* (Günther, 1864), one Characididae, *Characidium* n. sp., and one Trichomycteridae, *Ituglanis amazonicus* (Steindachner, 1882). They were generally under leaves and branches along the edges, at places where the current was relatively low. Light hardly penetrated the forest canopy.

Etymology

The name of the species is dedicated to our friend Philippe Gaucher, who found the first specimens, for its fascinating work on Amazonian fauna.

Affinities

Rivulus gaucheri is unique by its dorsal and anal fins characteristics, its colour and dark bars pattern and the subdistal coloured area in male and female anal fin.

In addition, it differs also from some related *hartii* super-species congeners by the lack of the “*Rivulus* spot” (vs pre-

sent) at all ages in both sexes, and dorsal and anal fin rays counts, as it has D 8-9, A 14-15 vs D 9-11, A 16-17 for *R. amphoreus*, vs D 10-13, A 17-19 for *R. igneus*, vs D 8-11, A 15-18 for *R. hartii* and vs D 9-10, A 15-17 for *R. holmiae*. For the other related *hartii* super-species congeners, it differs by dorsal and anal fin rays counts as it has D 8-9, A 14-15 vs D 7-8, A 10-11 for *R. torrenticola*, vs D 9-10, A 14-15 for *R. waimacui* and vs D 9-11, A 15-17 for *R. immaculatus*.

It differs also by the lack of the “*Rivulus* spot” (versus present) for *R. lungi*, and *R. urophthalmus*.

Distribution

Rivulus gaucheri is known from the south west of French Guiana, in the mountains of Mitaraka (Fig. 1), in upper Maroni basin (Litany). Its occurrence seems to be restricted to small isolated area.

Conclusion

In the Atlas of freshwater fish of French Guiana, which recapitulates the data relating to the inventories carried out in this area until the year 2000 (Planquette *et al.*, 1996, Keith *et al.*, 2000; Le Bail *et al.*, 2000), eight species of rivulin are quoted: *Kryptolebias ocellatus* (Hensel, 1868), *R. xiphidius* Huber, 1979, *R. lungi* Berkenkamp, 1984, *R. igneus* Huber, 1991, *R. holmiae* Eigenmann, 1909, *R. agilae* Hoedeman, 1954, *R. cladophorus* Huber, 1991 and *R. geayi* Vaillant, 1899. However, these inventories were carried out in the lowlands areas and the data relative to highlands are very rare. The recent expedition on the Mitaraka, in the south of French Guiana, has revealed the presence of a new taxon, and 9 species are known now in the family of Rivulidae in this country. The new *Rivulus* is unique among those known in French Guiana. The key below makes it possible to distinguish these various species.

It is possible that new collections in the sources area of the other large river basins of French Guiana reveal the presence of another species of *Rivulus* whose distribution remains often geographically limited. A new *Kryptolebias* was indeed recently found in high drainages of Surinam (Vermeulen and Hrbek, 2005).

Key of *Rivulus* and *Kryptolebias* of French Guiana

- 1a. - Species living in marine environment or brackish water. Coloration generally dull. Supracaudal and postopercular ocellus always present*Kryptolebias ocellatus*
 1b. - Freshwater species. Generally bright colours in males. Supra-caudal ocellus sometimes present in female, no postopercular ocellus (sometime a dark spot)2
- 2a. - Presence of a broad and black longitudinal band over the entire length of the body..... *Rivulus xiphidius*
 2b. - Presence of a punctuation on sides forming some longitudinal lines3
 2c. - Longitudinal lines, when exist, limited to the anterior part of the body. Presence of orange and blue rafters on the posterior part of the sides4
- 3a. - Frontal squamation E-patterned. Less than 43 scales in lateral line. Male with a slightly punctuated caudal fin at its base and with (sometimes without) black margins and sometimes yellow submargins. Female with or without a supracaudal ocellus and with an irregularly punctuated caudal fin5
 3b. - Frontal squamation D-patterned. More than 46 scales in lateral line. Male with a strongly punctuated bright orange caudal fin, with or without black margins. Female without supracaudal ocellus and with strongly punctuated fin
*Rivulus igneus*
 3c. - Frontal squamation E-patterned. More than 44 scales in lateral line. Male with a red caudal fin with black margins. Female with a supracaudal ocellus and a punctuated caudal fin at its base*Rivulus holmiae*
- 4a. - Male with an orange caudal fin with a black lower margin and a yellow submargin. Female with a supracaudal ocellus. Black mottled caudal fin.....*Rivulus agillae*
 4b. - Male with an orange caudal fin with longitudinal blue bands. Female, idem, but less brilliant
*Rivulus cladophorus*
 4c. - Male with caudal fin with red and blue vertical bars. Female with an optional supracaudal ocellus. Caudal fin translucent, sometimes punctuated*Rivulus geayi*
- 5a. - Female with a supracaudal ocellus. Absence of vertical irregular brownish bars on sides. Red and blue punctuations forming longitudinal lines on sides. Distributed in the lowland areas.....*Rivulus lungi*
 5b. - Female without a supracaudal ocellus. Numerous vertical irregular brownish bars on sides. Brown and black punctuations forming longitudinal lines on sides. Distributed in the highland areas.....*Rivulus gaucheri*

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