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## *RIVULUS TORRENTICOLA* N. SP. (ACTINOPTERYGII: CYPRINODONTIFORMES: RIVULIDAE), A NEW KILLIFISH FROM HIGHLANDS IN THE GUYANA SHIELD

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### ABSTRACT

*Rivulus torrenticola* n. sp. is described from small tributaries of the Kamarang River, which itself is a left bank tributary of the Mazaruni River in Guyana. *R. torrenticola* is a small, non-annual species. Males are distinguished from other *Rivulus* spp. by their long dorsal, anal and pelvic fins, by their truncate caudal fin and by their two longitudinal, dark lines on the body. Females have rounded fins and dark pigment on the body. They lack a so-called *Rivulus*-spot. *R. torrenticola* is reminiscent of *R. gransabanae* Lasso et al., 1992, with which it was likely encountered around Imbamadai.

### INTRODUCTION

The Guyana highlands were visited from 13 January to 7 February 1992, at the end of the dry season. The purpose of this visit was the collection of additional specimens of a *Rivulus* species hitherto unknown to science, captured by Dr Patrick de Rham in 1976. His specimens were deposited in ZMA 115.035 and examined for this paper; they are included in the paratype series. On 23 January the senior author arrived at Kamarang where *R. torrenticola* was collected at once; these specimens were not preserved. Several times during the next five days he collected the Kamarang and Mazaruni rivers up to Imbamadai. *R. torrenticola* was found in three colour variations.

### MATERIALS AND METHODS

Part of the material was preserved in the field, other specimens were brought home alive. Preserved specimens were measured with Mututoyo digital dial callipers, which show the measurements in hundredths of millimeters, according to most of the methods used by Hoedeman (1959: 46-47, fig. 22). The differences with his methods are: body depth (BD) taken at the anal fin origin; head depth (HD) taken at the posterior margin of the preoperculum; record of orbital diameter; record of longest anal fin ray and record of longest dorsal fin ray. Measurements are expressed in mm. Fin ray counts were made with a dissecting microscope with light transmitted through the fins. Some specimens were cleared and stained.

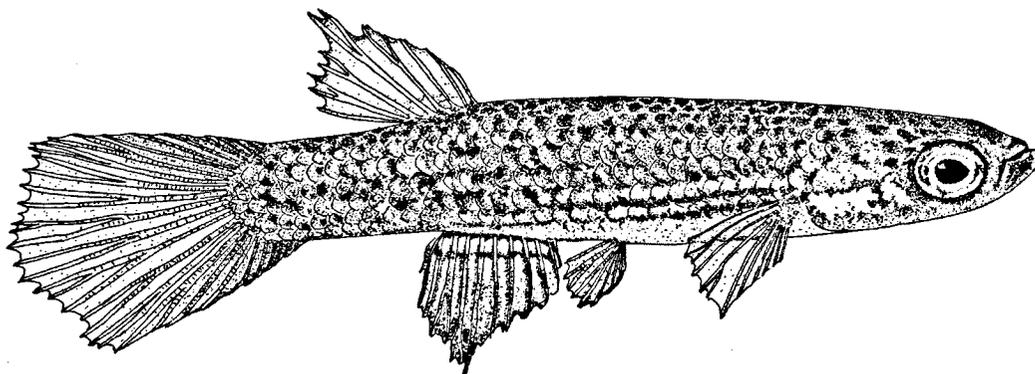


Fig. 1. *Rivulus torrenticola* n.sp., male.

## SYSTEMATICS

### ***Rivulus torrenticola* n. sp.**

Figs. 1, 2

**MATERIAL.** - Holotype: ZMA 123.467, male, 28.2 mm, and allotype: ZMA 123.468 female, 28.1 mm: Guyana, Upper Mazaruni Reserve, near Kamarang village, little creek at right bank of the Kamarang River, half a mile up from the landing of the general store of Paul James, 05° 50'20"N 60° 30'58" W, coll. F. B. M. Vermeulen, 25-I-1992, station number GY 92-12.

Paratypes, all from Guyana, Upper Mazaruni Reserve, collected by F. B. M. Vermeulen (unless specified otherwise): ZMA 123.469, male, 27.3 mm; Mazaruni River, right bank, 5 miles upstream from the Kamarang River junction, second rivulet, 05°50'08" N 60° 30'30" W, coll. 26-I-1992, station # GY 92-15; ZMA 123.470, male, 19.5 mm; Mazaruni River, right bank, 3 miles upstream from the Kamarang River junction, Eni-creek, 05°50'05" N 60° 30'38" W, coll. 26-I-1992, station # GY 92-14; ZMA 123.471, male, 25.3 mm, Mazaruni River, left bank, first little creek upstream from Imbamadai village, 05° 50'08" N 60° 20'50" W, coll. 28-I-1992, station # GY 92-21; ZMA 123.472, female, 26.8 mm; ZMA 123.482, 2 males, 22.5-27.7 mm; cleared and stained, Mazaruni River, left bank, second rivulet, 4 miles upstream from Imbamadai village, 05°40'00" N 60° 20'50" W, coll. 28-I-1992, station # GY 92-22; ZMA 123.473, male, 21.3 mm, left bank of Mazaruni River, third rivulet, 7 miles upstream from Imbamadai village, 05°30'55" N 60°20'50" W, coll. 28-I-1992, station # GY 92-23; ZMA 123.474, male, 20.2 mm; ZMA 123.475, female, 19.8 mm; ZMA 123.476, male, 19.7 mm; ZMA 123.477, male, 26.5 mm;

ZMA 123.481, 2 juveniles, both 18.1 mm; cleared and stained, Membaru River, second rivulet on right bank from the point where Membaru River tribute the Mazaruni River, 6 miles downstream from Kamarang. 05°50'35" N 60°30'35" W, coll. 24-I-1992, station # GY 92-11; ZMA 123.478, male, 28.6 mm; ZMA 123.479, female, 31.7 mm; ZMA 123.480, female, 31.3 mm, Membaru River, right bank, first rivulet about 2 miles up from the point where Membaru River tribute the Mazaruni River, 05°50'35" N 60° 30'35" W, coll. 24-I-1992, station # GY 92-10; ZMA 115.035, 2 juveniles, 16.0-17.4 mm, tributary to the Membaru River, 05°50' N 60° 30' W, coll. P. de Rham, 13-10-1976 (originally identified as *Rivulus* cf. *frenatus* Eigenmann, 1912).

**DIAGNOSIS.** - Distinguished from other *Rivulus* species by its small overall size, by its pigmentation characteristics and by the long dorsal, anal and pelvic fins in males.

**DESCRIPTION.** - A small *Rivulus*. Morphometric data of the holotype, allotype and of 12 paratypes from different localities are given in Table 1. Males have longer dorsal, anal and pelvic fins than females. Some of the larger specimens were preserved after having been kept in aquariums for approximately six months. All have the  $\epsilon$ -type frontal scalation pattern (Hoedeman, 1958: 24, fig. 1c); however, one was damaged and one is juvenile, obscuring the visi-

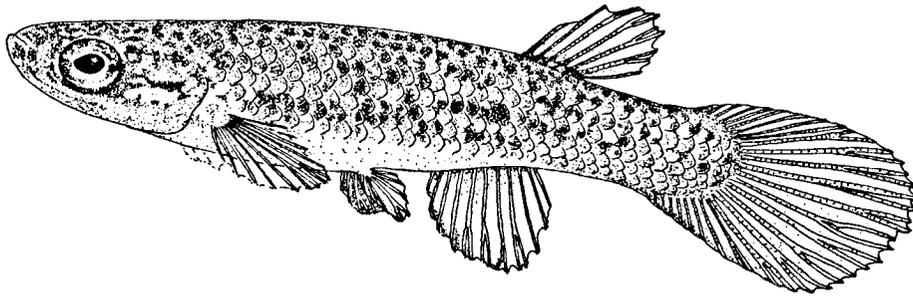


Fig. 2. *Rivulus torrenicola* n.sp., female, Membaru River, second rivulet.

bility of head scales.

Specimens from Membaru, raised in aquarium, remained smaller (ca 5 %) and more slender (ca 5%) than those from Kamarang and Imbamadai, which were kept under similar conditions.

Colour in life. - A 'Rivulus-spot' is lacking in this species at all ages in both sexes. Males: head reddish brown to brown; anteriorly grey brown with irregular dark brown spots. From the lower lip a horizontal dark band extends to the distal end of the gill cover, continuing posteriorly as two or three dark brown to black stripes. These stripes reach to just above the insertion of the last anal fin ray. Stripes are more well-defined in younger males than in fully adult ones. Above and between the stripes is a turquoise hue; below the stripes the abdomen is whitish. The gill cover is yellow below, the chin and region around the branchiostegal membrane are whitish. Iris yellow with some brown around the pupil. Dorsal fin almost clear, without markings, with a slight pale red hue and some iridescent colours along its base. A wine red hue on upper and lower parts of the caudal peduncle. Anal fin rays aubergine red, membranes turquoise at the base, fading towards the distal margin. Margin with a thin dark band. Just below the base, a thin aubergine band runs parallel to the body. Caudal fin hyaline with wine

red hue, more intensive red extends along upper and lower parts of the caudal peduncle into the fin. Some specimens show dusky spots in the centre of the caudal fin. Ventral fins dusky green, the first three rays with a dark edge. Pelvic fins are clear.

Females: head and dorsum of body brown to greyish brown. Sides pale yellowish brown. From the insertion of the pelvic fins to the lower part of the base of caudal peduncle, the body has irregular, vague dark brown spots. Abdomen, region of the branchiostegal membrane and chin are whitish. Fins clear. In some specimens the anal fin has a pale marginal band which is less distinct than in males. Unpaired fins roundish, pectoral and pelvic fins shorter than in males.

Colour slides of authentic specimens are at hand, which are soon intended for publication elsewhere.

Colour in alcohol. - Males: head and dorsum of body dark brown, laterally becoming yellowish-brown. Two well marked rows of dark scales from pelvic fin insertions to last ray of anal fin. The upper row fades to irregular dark brown blotches, which extend to the caudal peduncle. Chin, lower half of gill cover and abdomen whitish. Pectoral fins dusky, without markings. Pelvic fins dusky with a brownish margin. Dorsal fin yellowish brown, brown just above its base, the

Table 1. *Rivulus torrenticola* n. sp. Measurements (in mm) and counts.

Register # (ZMA)	123.467	123.468	123.478	123.479	123.474	123.475	123.476	123.480	123.477	123.469	123.470	123.471	123.472	123.473
Status	holotype male	allotype female	paratype male	paratype male	paratype male (juv.)	paratype male	paratype female	paratype male						
Sex	male	female	male	female	male	female	male	female	male	male	male (juv.)	male	female	male
Total length	28.2	28.1	28.6	31.7	20.2	19.8	19.7	31.3	26.5	27.3	19.5	25.3	26.8	21.3
Standard length	35.1	34.4	34.9	39.0	25.7	25.2	24.8	38.8	32.0	34.8	25.3	31.0	33.7	26.9
Length of head	7.2	7.3	7.9	8.3	6.5	5.8	5.9	8.0	7.4	7.4	5.2	7.4	6.9	5.5
Greatest depth of body	6.9	6.5	6.2	8.1	4.0	4.0	3.6	7.2	5.5	7.0	3.6	6.5	6.5	3.6
Length of snout	1.0	0.9	1.9	1.6	0.8	1.0	1.1	1.5	1.4	0.9	0.8	1.2	1.2	0.7
Eye diameter	2.4	2.7	2.4	3.3	1.9	1.9	1.7	3.0	2.3	2.9	1.9	2.5	2.8	2.2
Postorbital length of head	3.3	3.6	3.4	3.5	2.5	3.0	2.9	3.5	3.2	3.5	2.6	3.4	2.9	2.7
Width of fleshy orbit space	3.2	2.7	2.6	3.3	2.3	2.4	2.4	3.9	2.9	3.1	1.8	2.9	3.1	1.6
Distance between base of anal fin ray-midcaudal fin base	10.5	10.6	6.9	7.0	4.6	4.2	4.9	7.2	10.2	10.6	7.7	10.1	9.5	9.3
Least depth of caudal peduncle	5.1	4.0	4.5	5.0	2.8	2.7	2.9	5.1	4.1	5.4	2.8	4.4	4.4	2.7
Greatest width of head	5.8	5.5	6.0	6.4	3.6	3.9	3.9	6.8	5.2	5.9	3.4	5.2	5.7	3.9
Snout to dorsal origin	18.8	18.8	20.0	22.6	14.0	14.3	14.1	21.5	18.5	19.2	12.3	17.4	19.8	14.1
Snout to anal origin	18.1	17.8	18.6	20.6	12.7	10.4	12.5	19.7	17.3	17.1	12.0	15.9	18.3	13.4
Snout to pelvic insertion	14.7	14.4	8.0	8.8	6.0	4.5	5.5	15.4	14.1	13.8	9.8	13.1	14.7	10.2
Snout to pectoral insertion	7.2	7.2	14.6	16.3	10.3	9.8	10.4	7.6	7.6	7.0	5.3	7.2	7.8	5.8
Length of longest dorsal fin ray	7.8	4.6	4.3	5.0	3.4	3.8	3.4	5.9	5.8	8.3	2.6	5.1	4.3	4.2
Length of longest anal fin ray	7.4	4.3	4.2	4.8	4.7	3.9	3.6	5.4	6.9	8.3	4.3	6.6	3.9	5.1
Length of longest pelvic fin ray	3.2	2.4	2.6	2.8	1.9	1.9	2.3	3.0	3.0	3.6	1.8	2.9	2.7	2.2
Length of longest pectoral fin ray	5.0	4.8	4.7	4.4	2.9	3.1	3.9	5.5	5.1	5.5	3.6	4.3	4.2	4.1
Length of dorsal base	2.9	2.5	2.8	3.1	2.1	2.0	1.6	2.9	2.6	3.0	1.9	2.5	2.3	2.1
Length of anal base	4.4	3.7	4.0	4.4	3.1	3.4	2.6	4.3	3.6	4.1	2.7	3.6	3.3	3.1
Number of dorsal fin rays	8	8	8	8	8	8	8	8	7	8	8	8	8	8
Number of anal fin rays	11	10	11	11	11	11	11	11	10	11	10	11	11	11
Number of pectoral fin rays	14	14	15	14	14	14	14	14	14	14	14	14	14	14
Number of pelvic fin rays	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Number of scales from head to caudal fin base	31+2	31+2	31+2	31+2	31+3	32+2	32+2	33+2	31+2	32+2	31+2	31+2	31+2	31+2
Number of scales between anal and dorsal fin base	9	9	9	9	9	9	9	9	9	9	9	9	9	9

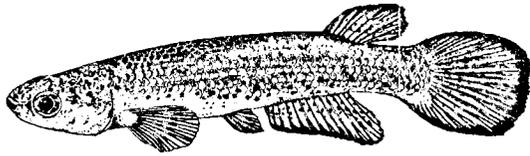


Fig. 3. *Rivulus immaculatus* Thomerson et al., 1991, male, sympatric with *R. torrenticola* n.sp. at Imbamadai; drawing included for comparison.

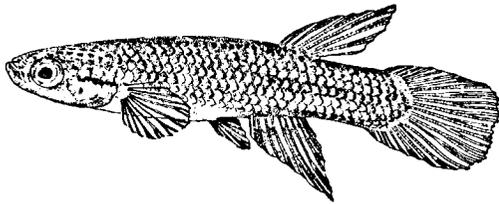


Fig. 4. *Rivulus* cf. *gransabanae* Lasso et al., 1992, male, sympatric with *R. torrenticola* n.sp. at Kamarang; drawing included for comparison.

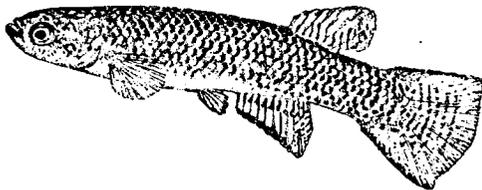


Fig. 5. *Rivulus breviceps* Eigenmann, 1909, male, from top of Kaieteur Falls, Potaro River; drawing included for comparison with *R. torrenticola* n.sp. (Drawings by the senior author).

rays blackish. Anal fin yellowish brown with dark pigment just below its base, the rays blackish. Caudal fin pale yellow, the rays blackish.

Females: head and dorsum of body as in males, but bands and lines less distinct. Blotches are present on the entire body. In some specimens these blotches form a pattern, in others they may be virtually absent. All fins dusky, except for the anal fin, which has a dark pattern like in males, but less clear. Dorsal, anal and caudal fins with dark pigment on their rays.

**HABITAT.** - *Rivulus torrenticola* was encountered in narrow and shallow streams in the rocky highlands tributing directly to the main rivers. These streams run rapidly during or just after the heavy rains which occur even also during the dry season almost every night and early in the morning. *R. torrenticola* was the only fish found in the lower sections of these streams, which are heavily shaded and full of rocks and fallen trees.

*Rivulus immaculatus* Thomerson et al., 1991 (Fig. 3) was found at the type locality of *R. torrenticola*. This is at the head of the creek, which is a swampy and slow running section, where the people from Kamarang use to do their laundry. This habitat is open and sunny, shallow, with grass and low bushes. In the fast running, strongly shaded, downhill section of this creek, just about a hundred meters downstream, *R. immaculatus* was not collected whereas *R. torrenticola* was encountered. They may use to live in separate parts of the stream.

At one spot, *R. torrenticola* was present in the lower part of such a stream. In the swampy open area on top of the hill it was not found, but *R. immaculatus* was present there. *R. torrenticola* was once found together with a small characoid fish, *Poecilocharax* sp., outside the hill with slow running water.

*R. torrenticola* was found in small numbers. They reside under leaves, rocks and branches along the edges, at places where current is relatively low. They occur in rain water streams with a sandy or rocky bottom without vegetation. pH values are 4.3-4.9, hardness GH < 1, KH < 1. Where these streams join the river, a shallow dam of sand and mud is being deposited, which forms an obstacle for potential intruders from the river, especially if there is no rain. Temperature in the morning was 21° C. No measurements were taken later in the day, but it is unlikely that temperature fluctuates much. Light hardly penetrates the forest canopy. When kept in captivity the temperature should be between 21°-23° C, while the oxygen level should be high. Breeding this species in captivity was not easy.

*R. torrenticola* was not found in larger streams. In the latter biotope it might be subject to strong predation. This may be an explanation of the apparently many isolated populations with different colour patterns occurring in a relatively small

area. Isolation of such populations is also enhanced by the mountainous area and by the slope of most habitats. During the rainy season the forest floor is not inundated, so these creeks usually remain isolated from each other. The stair like profile of these streams and the daily lack of rain during some hours, prevent potential intruders from entering these extreme habitats. This provides *R. torrenticola* with an unique niche, allowing it to maintain viable populations in spite of a low number of offspring.

**DISTRIBUTION.** - The area around Kamarang up to Imbamadai. Probably it occurs in the entire Upper Mazaruni district, including the lower Kamarang River most likely up to its source in the Gransabana Savannah in Venezuela. Its occurrence seems to be restricted to small streams with fast running water.

**ETYMOLOGY.** - The name *torrenticola* is from the Latin *torrens*, *-entis* (masculine) meaning swift or violent stream plus *-cola* (masculine) meaning dweller, inhabitant, in allusion to its habitat.

## DISCUSSION

At Imbamadai *R. torrenticola* was caught together with *R. cf. gransabanae* Lasso et al., 1992 (Fig. 4). *R. cf. gransabanae* has scales and fin rays similar to *R. torrenticola*. It was found once at station GY 92-21, the second stream at the left bank upstream from Imbamadai (ZMA 123.482). *Rivulus cf. gransabanae* differs from *R. torrenticola* by an average higher number of dorsal fin rays. Moreover, it differs in pigment pattern of the sides, which may be absent, and in its somewhat more robust shape of the body. Crossbreeding attempts over a period of six months were unsuccessful. The deep, robust caudal peduncle of *R. torrenticola* is also present in other species residing in fast running, narrow creeks, e.g., *R. breviceps*, *R. lyricauda* and *R. gransabanae*.

*R. torrenticola* also shares the deep and robust caudal peduncle, the elongate dorsal, anal and caudal fins and the short snout with *R. breviceps* Eigenmann, 1909 (Fig. 5), *R. lyricauda* Thomerson et al., 1991, and with *R. gransabanae*.

Reproduction is non-annual. Eggs are relatively large (1.9-2.1 mm), they are dark amber.

Development of the eggs proceeds without identifiable diapause and lasts 16-23 days. The number of offspring is low and in the field young were not abundant.

## ACKNOWLEDGEMENTS

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