

***Renova oscari*, a new genus and species of annual killifish from Venezuela (Cyprinodontiformes: Rivulidae)**

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Renova oscari, new genus, new species, an annual rivulid killifish, is described from specimens collected on Isla Raton, Upper Río Orinoco, Amazonas State, Venezuela. Proposed phylogenetic relationship of *Renova* is (*Neofundulus* (*Renova* (*Trigonectes* + *Moema*))). The principal autapomorphy of both the new genus and species is the presence of bifurcate first hypobranchials, each of which consists of two separate ossifications. Males are green with five to seven red lateral stripes, have short pelvic fins, and extensions of the central caudal rays. Females may or may not have a 'rivulus spot'. It was collected from a temporary pool along with *Pterolebias xiphophorus*, *Terranatos dolichopterus*, and *Rivulus* sp.

Se describe el pez anual *Renova oscari* (Rivulidae) como género y especie nuevos para la ciencia. El mismo fue colectado en Isla Raton, del Alto Río Orinoco, estado Amazonas, Venezuela. La filogenia propuesta para *Renova* es (*Neofundulus* (*Renova* (*Trigonectes* + *Moema*))). La principal autapomorfía tanto del género como de la especie nueva es que tienen los primeros huesos hipobranquiales bifurcados, y cada uno de los cuales consiste de dos huesos pequeños separados. Los machos son verdes con cinco a siete hileras de franjas laterales rojas, tienen las aletas pélvicas cortas, y extensiones de los radios centrales de la aleta caudal. Las hembras pueden o no tener una 'mancha rivulus'. Se colectaron de un pozo estacional, juntos con *Pterolebias xiphophorus*, *Terranatos dolichopterus*, y *Rivulus* sp.

Introduction

Continued discovery of new and novel species of Neotropical rivulid killifishes reminds us that the welcome efforts of Parenti (1981) and Costa (1990a-b, 1991, 1992) to clarify generic relationships within the Rivulidae have provided us with provisional hypotheses of relationships within a group not yet well known, rather than a stable

generic-level taxonomy for the family. The new species described below does not conform well to any of the generic diagnoses given by Costa (1990a-b, 1991, 1992), but does seem to be a member of his subtribe Neofundulina (Costa, 1990a-b, 1992). Description of a new genus for a single species, as proposed here, can be justified on either of two grounds, both of which apply: (1) the species cannot be comfortably accommodated

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within an existing genus; and (2) in a proposed phylogeny, the species is the only known representative of the sister taxon of other clades treated as genera (in this case *Trigonectes* Myers plus *Moema* Costa).

Methods

Measurements were made with Helios dial calipers. Counts and measurements were made following Hoedeman (1959), with the exception that head depth was measured at the posterior margin of the preopercle. Measurements not taken by Hoedeman include prepelvic-fin insertion length (tip of snout to level of pelvic-fin origin), snout length (tip of snout to level of anterior edge of orbit), and orbit diameter (measured parallel to body axis). Ratios are expressed as percentages. Counts were made on preserved specimens under a dissecting microscope; fin ray counts were made using transmitted light, and all visible fin rays were counted. Life color descriptions were based on field notes, color slides and observation of wild-caught and F1 fish in the aquarium. Figure 2 was drawn with camera lucida from the largest of four specimens cleared and counterstained with Alizarin Red S (Taylor, 1967). Institutional abbreviations follow Leviton et al. (1985). The MAC-PAY collection was deposited at the FONAIAP station, Puerto Ayacucho, Amazonas, Venezuela.

Renova, new genus

Type species. *Renova oscari*, new species.

Diagnosis. *Renova* differs from *Moema* Costa, 1989 as diagnosed by Costa (1992) in: having fewer vertebrae (31-33 in *Renova*, vs. 36-37 in *Moema*), side profile of head not elongated (vs. side profile of head elongated), a smaller maximum size (less than 80 mm SL, vs. maximum size 80 mm SL or larger), medial process of first hypobranchial strongly bifurcated (medial process of first hypobranchial not bifurcated), teeth present on the second pharyngiobranchial (vs. no teeth on the second pharyngiobranchial).

It differs from *Trigonectes* Myers, 1925 as diagnosed by Costa (1990b) in: dorsal and ventral surfaces of dentary not parallel, and no molar

pharyngeal teeth. In addition: males have short pelvic fins (vs. males with elongate pelvic fins), and males have central rays of caudal fin elongated (vs. male caudal fin rounded).

This new genus differs from *Neofundulus* Myers, 1924 as diagnosed by Costa (1990b) in: males have only a weakly developed light stripe along anal-fin base (Fig. 1), (vs. this stripe strongly developed in males), young and females with no to variably-expressed transverse caudal-fin bars (vs. with strongly expressed transverse caudal-fin bars). In addition: dentary not reduced (vs. reduced; Costa, 1990a), predorsal length more than 70 % SL (vs. much less than 70 % SL), vomer with some 14 teeth (vs. with 1-3 teeth; Costa, 1992). Male pectoral fin lanceolate, dorsal and anal fins pointed with filamentous extensions, and caudal fin with extended medial rays (vs. margins of all fins rounded in males).

Description. The principal autapomorphy for *Renova* is the presence of bifurcate first hypobranchials, each of which consists of two separate ossifications (Fig. 2). Character states for *Renova* are described below for each synapomorphy proposed by Costa (1990a-b) for the various generic-level or higher taxa he recognized within the rivulinae. For convenience in making comparison, they are numbered following Costa (1990a: 80-81): 13. caudal fin less than 45 % scaled, only five or six scale rows onto base of fin; 14. anterior process of quadrate present; 15. pectoral fin not reduced; 16. rivulus spot in females either absent or present; 17. annual fishes; 18. lower tip of cleithrum exterior to coracoid; 19. neural prezygapophyses of precaudal vertebrae relatively short; 20. first hypobranchial bifurcated; 21. interarcual cartilage not reduced; 22. proximal anal radials moderately expanded; 23. male caudal fin not expanded; 24. usually seven pelvic rays, occasionally eight; 25. no notch in ascending process of premaxillary; 26. no elongated humeral spot; 27. no preopercular canal; 28. four or five lateral rows of dark dots (intermediate rows often well developed in males, rows of dots more developed in males than in females); 29. pelvic-fin bases separated; 30. 31-33 vertebrae; 31. ascending process of preopercle broad; 32. males with complexly-pigmented caudal and anal fins, but poorly-developed light stripe along anal-fin base; 33. young and females with no to variably expressed transverse caudal-fin bars;

34. same as 13.; 35. dentary not reduced; 36. maximum SL less than 80 mm; 37. side profile of head not pointed; 38. first epibranchial reduced; 39. predorsal length 70-76 % SL (Costa gives 'distância préanal cerca de 70 % do comprimento padrão'; anal-fin origin is never that far posterior in rivulids, and we presume he intended to refer to predorsal length); 40. dorsal and ventral surfaces of dentary not parallel; 41. anterior medial process of angulo-articular not elongated; 42. no molar pharyngeal teeth; 43. pectoral fin lanceolate; 44. ascending process of the premaxillary broad, twice as long as wide; 45. no anterior ventral process on dentary.

Etymology. *Renova* is based on the Latin word for renew, in reference to its annual life history, with renewal of the adult population each rainy season. *Renova* also honors the students of the Programa de Ingeniería de Recursos Naturales Renovables de la UNELLEZ, who first collected this fish during a class field trip.

Gender. Feminine.

Renova oscari, new species

(Fig. 1)

Holotype. MCNG 27070, male, 46.8 mm SL; Venezuela: Amazonas State: southwest edge of Isla Raton near the village of Sabanita, downstream from the mouth of a small stream emerging from the island, upper Río Orinoco; 5°05'N 67°48'W; D. Taphorn, R. Brousseau, O. León M., J. Rondon and Sr. Martínez; August 14, 1992.

Paratypes. MCNG 26441, 12 specimens + 4 cleared & stained, 36.1-46.8 mm SL; MZUSP uncat., 3 males, 3 females, 30.6-43.3 mm SL; Venezuela: Amazonas State: southwest edge of Isla Raton near the indian village of Sabana de Raton; 5°07'20"N 67°48'30"W; O. Leon M., S. Palacios, A. Perez, September 5, 1991. - MCNG 27068, 13 specimens; MAC-PAY 2462, 1 male, 44.7 mm SL, 4 females, 34.4-36.7 mm SL; FMNH 104897, 2 males, 2 females, 31.2-42.4 mm SL; CAS 81654, 2 males, 2 females, 30.5-45.5 mm SL; taken with holotype.

Diagnosis. As for the genus.

Description. As for the genus. In addition: slender flat-headed confirmed (Thomerson & Tap-

Table 1. *Renova oscari*, morphometric data for holotype; means and ranges for type series.

	holotype	six males			five females		
		min	avg	max	min	avg	max
Standard length (mm)	46.8	35.4	42.4	46.8	32.0	34.1	36.6
In percents of standard length							
Total length	142	139	146	156	131	134	136
Predorsal length	70.7	70.7	71.3	72.3	71.6	73.2	75.6
Preanal length	63.0	56.3	62.0	64.1	61.7	64.4	66.9
Prepelvic-fin insertion length	50.2	50.2	51.3	52.2	50.3	52.9	55.9
Greatest body depth	23.5	21.1	23.3	24.4	22.4	22.9	23.4
Caudal peduncle depth	16.2	15.0	16.0	16.8	13.5	14.5	15.8
Head length	27.4	25.7	27.6	29.3	27.3	28.9	30.1
Length of pectoral fin	25.2	23.7	27.2	31.6	22.1	24.5	26.4
Length of pelvic fin	13.0	13.0	14.1	15.9	11.7	13.5	14.9
Length of dorsal fin-base	11.1	9.8	10.4	11.1	9.0	10.0	10.8
Length of dorsal fin	33.5	26.8	30.1	33.5	24.0	25.2	26.4
Length of anal-fin base	16.5	15.2	16.1	17.2	13.1	14.5	15.2
Length of anal fin	57.3	31.6	48.4	62.8	27.6	29.1	31.6
In percents of head length							
Orbit diameter	30.0	30.5	32.6	33.3	30.0	32.3	33.3
Head width	63.0	62.5	65.6	69.6	65.0	66.7	67.7
Head depth	61.7	55.6	58.5	61.7	52.0	54.4	59.1
Snout length	10.9	10.9	12.9	14.3	9.0	10.1	10.9

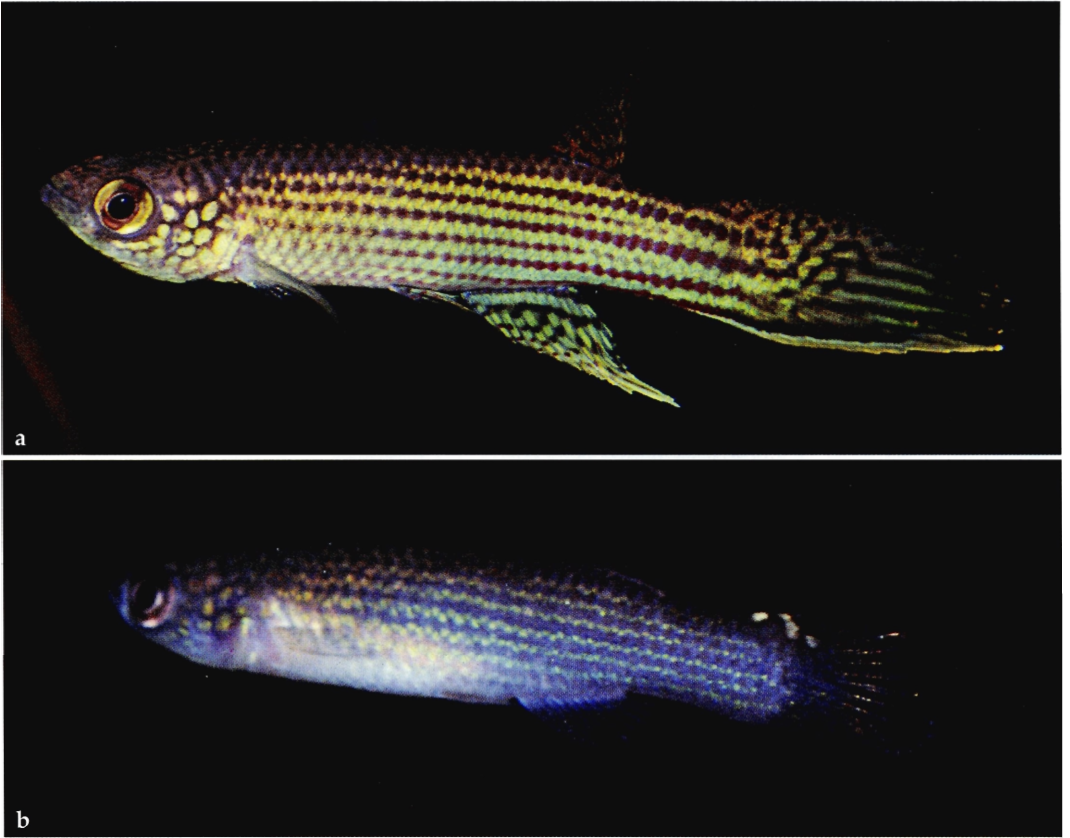


Fig. 1. *Renova oscari*, from the type locality. a, male, about 45 mm SL; b, female, about 30 mm SL, showing rivulus spot (photographs by DCT).

horn, 1992) annual killifishes. Males larger than females, with relatively larger caudal fin with extensions of the central fin rays, longer lanceolate pectoral fins, longer dorsal fin, longer anal-fin base, greater anal-fin length, deeper caudal peduncle, and longer snout (Table 1). Number of (* indicates count for holotype): lateral scales 32(3), 33(4), 34(3), 35*(1); transverse scales 9*(11); dorsal-fin rays 10(3), 11*(8); anal-fin rays 13(1), 14(2), 15*(7), 16(1); left pectoral-fin rays 15(1), 16*(6), 17(4); left pelvic-fin rays 7*(9), 8(2). See Table 1.

The first hypobranchial (Fig. 2) of *R. oscari* is unusual in that it consists of two bones articulated together rather than being a single bone. The mesial ossification bears two mesial hollow conical processes; the anterior process abuts the juncture between the first and second basibranchials, and the posterior process abuts a lateral concav-

ity near the middle of the second basibranchial. The processes are free for the mesial third of their length, joined by a thin flange of bone for the middle third of their length and confluent for the lateral third of their length. A thickened knob of bone at the lateral end of the two processes serves as an articulation point with the distal ossification of the first hypobranchial. Thin triangular lateral flanges of bone, which extend from the base of the articulation knob and run along two-thirds the external length of the processes, project on both anterior and posterior sides of the mesial ossification. The distal ossification has a mesial articulation knob with similar flanges extending anterior and posterior, complementary to the distal flanges of the mesial ossification. Free movement around this articulation point seems greater in a dorsal-ventral direction than in an antero-posterior direction. The lateral end of the

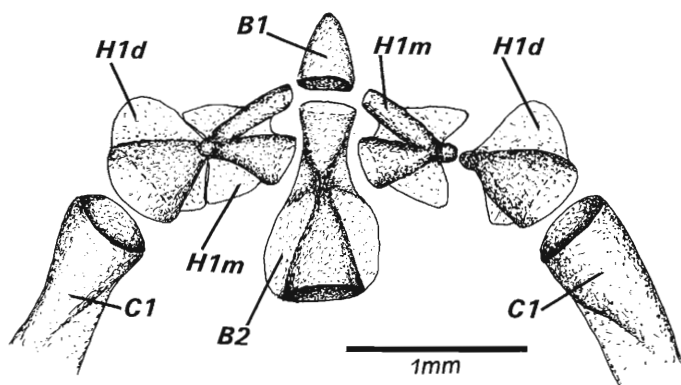


Fig. 2. Dorsal view of a portion of the anterior ventral gill arches of a male *Renova oscari*, about 45 mm SL, MCNG 26441. Cartilage is not shown. Abbreviations: **B1**, first basibranchial; **B2**, second basibranchial; **H1m**, first hypobranchials: mesial ossification; **H1d**, first hypobranchials: distal ossification; **C1**, bases of first ceratobranchials. Right first hypobranchial shown disarticulated.

distal ossification is a hollow cone-shaped process, with its tip at the articulation knob. The open end of the process connects, through the usual cartilaginous pad, with the ventral end of the first ceratobranchial. The distal first hypobranchial ossification supports a single gill raker similar to those on the first ceratobranchial.

The ventral branchial arches of *R. oscari* seem robust in comparison to those of other rivulid killifishes. The fifth ceratobranchial is toothed with curved pointed teeth, as in most rivulids; in addition, the fourth ceratobranchial supports a mesial tooth patch of some four teeth and a single row of curved pointed teeth extending about two-thirds the length of its mesioposterior margin.

Coloration. Males iridescent green, with five to seven red to brown lateral stripes of confluent dots that converge posteriorly into three or four stripes on the caudal peduncle; these are expanded to cover the entire caudal peduncle in some males. Females plain tan, with little or no development of darker lateral stripes. Caudal fin of males usually with a ventral orange stripe, occasionally a dorsal orange stripe as well; center of caudal fin iridescent green, with red to brown dots, spots, and vermiculations (center is solid black in preserved specimens). Female caudal fin clear, with or without irregularly developed dusky bars. Male dorsal fin clear with numerous red dots arranged in rows, and sometimes an orange margin. Female dorsal fin clear with trans-

verse rows of dusky spots. Male anal fin similar to dorsal fin, but with iridescent green ground color, a stripe of ground color parallels the base of the anal fin, separated from the distal portion of the fin by a row of confluent red spots, distal margin of anal fin and anal fin filament white to

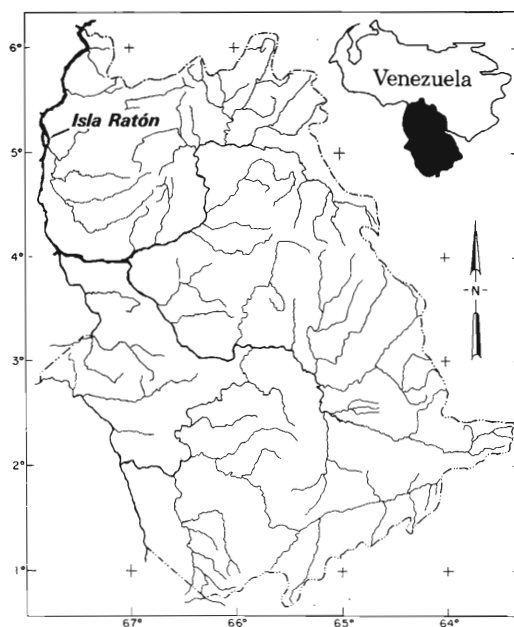


Fig. 3. Location of Isla Raton, type locality of *Renova oscari*, Amazonas State, Venezuela. Base map drawn by Darlene Harrison.

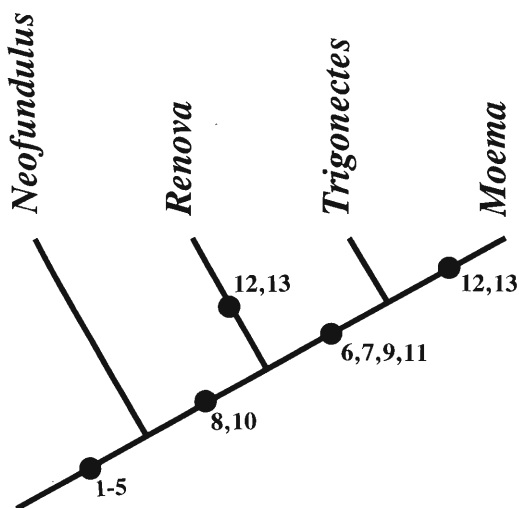


Fig. 4. Proposed phylogeny of the subtribe Neofundulina showing distribution of putative apomorphic characters (modified from Costa, 1992: fig. 4). 1, sides with five rows of dark dots; 2, bases of pelvic fins separated; 3, 33 or more vertebrae (31-33 in *Renova*); 4, upper process of preopercle broad; 5, first epibranchial reduced; 6, pointed lateral profile of head; 7, large size, 80+ mm SL; 8, vomer with 6 to 14 teeth; 9, nonbifurcate first hypobranchial; 10, caudal fin with 32-33 rays; 11, no teeth on second pharyngobranchial; 12, lanceolate pectoral fin, 13, ascending process of the premaxilla broad.

orange. Female anal fin clear. Pectoral fins with dusky transverse bars and a dark ventrolateral border in males, clear in females. Females are dimorphic, with or without an ocellated 'rivulus spot' (a dark dorsolateral spot usually situated on the caudal peduncle at the level of the caudal-fin base; characteristic of females of many species of *Rivulus* Poey).

Distribution. Known only from the type locality (Fig. 3), the different collections from Isla Raton were probably all made in different areas of the same large pool.

Etymology. *oscari* is a patronym honoring Sr. Oscar León Mata, the discoverer of the species, who has long assisted in our work on fishes with much enthusiasm and good cheer.

Phylogeny. We propose the hypothesis of relationship for *Renova* shown in Figure 4. This figure is modified from Costa (1992: 623, fig. 4) to include *Renova* and uses the same synapomorphy numbers. We have treated Character 12, elongated pointed pectoral fin in males (also seen in several species of *Pterolebias* Garman), and character 13, broad ascending process of the premaxillary (equally developed in *Renova* and *Moema* [see Costa, 1990a: fig. 8D]) as homoplasies. An equally parsimonious interpretation of these two characters would be to consider them as additional synapomorphies for the clade (*Renova* (*Trigonectes* + *Moema*)) with reversions to the plesiomorphic state in *Trigonectes*.

Renova oscari is presently known among killifish aquarium hobbyists as 'Moema sp. from Isla Raton'. We have rejected placing it in *Moema* because this would require treating four putative synapomorphies shared by *Trigonectes* and *Moema*, but not by *R. oscari*, as homoplasies. As shown in Figure 4, these are: 6. pointed side profile of head; 7. large size, 80 mm or more SL; 9. nonbifurcate first hypobranchial; and 11. no teeth on the second pharyngobranchial bone.

On external examination, a female *R. oscari* with a rivulus spot appears to be a female of some species of *Rivulus*. Rivulus spots are not universal among *Rivulus* species as has been stated by Parenti (1981) and Costa (1990a-b, 1991), but females of the majority of *Rivulus* species (and males of some) do have more-or-less well developed rivulus spots (see Huber, 1992: table 5.). Costa (1991) removed *Pituna stellifer* (Thomerson & Turner, 1973) from *Rivulus* and, in doing so, dismissed its rivulus spot (in females of that species, usually several closely-grouped irregular dark spots surrounded by a light area) as not homologous with similar markings of *Rivulus* species. Turner (1967), in describing female *Rachovia hummelincki* de Beaufort, 1940 originating from a collection made near Barranquilla, Colombia, stated '... infrequently there is a small but conspicuous ocellus bordering dorsal part of [caudal] fin origin'; i.e. a rivulus spot. Thus presence of well-developed, ocellated rivulus spots in some *R. oscari* females might be a plesiomorphic character state, not indicative of close relationship with any *Rivulus* species.

Discussion

Isla Raton (Fig. 3), Amazonas state, Venezuela, some 14 km long by 6 km wide at its widest point, is well isolated from either shore by major flowing channels of the Río Orinoco. It is just south and upstream of the Maipures Rapids and the village of Samariapo, and immediately northwest of the mouth of the Río Sipapo. When the 1991 and 1992 collections were made, the type locality was a large backwater pond. The pond was located on the southwest edge of the island, near the village of Sabanita. It was separated from the western mainstream of the Orinoco by a forested natural levee only a few meters wide. The pond was over 30 meters wide at this end, and spread out considerably more as it stretched inland, where it eventually merged with a stream of river water flowing across the island. A thick growth of scrubby, spiny bushes provided shade and cover near the river side of the pool, but the inland side was flooded savannah, with only scattered spiny bushes and vines. In 1992 water in the pond was tea-colored, at most 80 cm deep, and 30°C. The bottom of the pond was gray clay with abundant decaying aquatic plants: water lilies, other submerged and emergent aquatic plants, emergent sedges and grasses, and the flooded terrestrial spiny bushes provided abundant cover for fish.

In 1991, *R. oscari* was collected with *Pterolebias xiphophorus* Thomerson & Taphorn, 1992, and a *Rivulus* species. When the site was revisited the following year, *R. oscari* was found associated with the same two species, as well as *Terranatos dolichopterus* (Weitzman & Wourms, 1967). This latter record represents a considerable and unexpected range extension for an annual species we had thought confined to the Orinoco Llanos north of the Orinoco mainstream.

Besides the rivulid killifishes present, seven-teen species of river fishes (mostly small characids) were collected, including fish predators such as *Gymnotus carapo* and juvenile *Boulengerella lucia*. Even so, none of the killifishes showed nipped fins, as has been reported for annual killifishes associated with river fishes in the Llanos (Nico & Thomerson, 1989). Only adult killifishes were found; the largest individuals present were the male *R. oscari*, followed by *Rivulus* sp. individuals and female *R. oscari*, then *T. dolichopterus* (the

latter were quite robust, and the males had unusually long dorsal and anal fin-ray extensions). The smallest rivulids collected were adult *P. xiphophorus*, found mostly in the shallowest portions of the pool near the edge, in flooded savannah. Previously the latter species had been found almost exclusively in flooded forest (Thomerson & Taphorn, 1992).

Annual rivulids, though classically pictured as inhabitants of isolated rainwater pools, have been collected a number of times from the shallow backwaters of rivers. Often these shoreline habitats are left unstudied because they are far inland from the main channel and difficult to reach from the river itself. The shoreline of an island in or near the main channel cannot retreat very far, and we encourage our fellow ichthyologists, busy in the mainstream, to spend a little time seeking annual killifishes on river islands when the opportunity arises.

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