

Colour Variation of an Individual of Hart's Rivulus (*Rivulus hartii*) found in a Habitat Rich in Polycyclic Aromatic Hydrocarbons in the Pitch Lake of Trinidad

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Abstract. Typical coloured *Rivulus hartii* have been documented in South America and the twin island state of Trinidad and Tobago in habitats ranging from rock pools to slow moving streams. After repeated sampling at the Pitch Lake, an area rich in polycyclic aromatic hydrocarbons in Trinidad, a single individual was found within a pool of the lake with abnormal colouration. The fish exhibited normal behavior and showed no signs of pathology.

Key words: *Rivulus hartii*, Pitch Lake, colour variation.

Hart's rivulus (*Rivulus hartii*) is one of the larger members of the Killifish family (Cyprinodontidae family) in the ornamental trade. They have a natural distribution in Trinidad and Tobago and drainages along the northern coast of Venezuela, where they inhabit streams, swamps, ponds, and rock pools at the bases and above waterfalls (AXELROD & SCHULTZ, 1983). Adult males are light brown with blue-green hints. Longitudinal rows (approximately eight rows) of red spots from the operculum to the caudal peduncle are prominent. The caudal fin has yellow stripes to the top and bottom (Fig. 1). Females also have similar, but less intense coloration. The adult fish show clear sexual dimorphism when the fish reaches about 30mm total length (TL). Males develop a white fringe on the caudal fin, both dorsally and ventrally, whereas females have a black fringe at the periphery of the caudal fin (AXELROD & SCHULTZ,

1983). Females above 50mm TL and about 50-80% of all males have a dark pigmented spot on the dorsal part of the caudal peduncle which is also visible in juveniles. There is hardly any size difference between sexes of this species (AXELROD & SCHULTZ, 1983).

In Trinidad and Tobago Hart's rivulus has a wide distribution across both islands (KENNY, 1995; PHILLIP, 1998). PHILLIP (1998) showed their existence in south west Tobago, and we have observed specimen from both central (Gilpin Trail, UTM 20P: 759065.37 E, 1249820.56 N) and northern regions (UTM 20P: 767634.95 E, 1253366.84 N and 766369.16E, 1253366.84N) of the island in forested areas with seasonal streams. They show a greater diversity in habitat types in Trinidad, however, deviating from the typical freshwater habitat mentioned above. We have recorded them in small streams within less than 10.0 meters

Colour Variation of an Individual of Hart's Rivulus (Rivulus hartii)...

from sea water at salinities between 3‰ to 5‰, at both the west (Iros Bay, UTM 20P: 640103.04 E, 1123072.10N) and east coastlines (Mayaro, UTM 20P 719148.75 E,

1137293.55 N) in Trinidad. The most interesting site they have been recorded at, however, is the Pitch Lake (UTM 20P: 650341.45 E, 1131668.93 N) of Trinidad.



Fig 1. Normal coloured *Rivulus hartii*.



Fig. 2. Unique coloured *Rivulus hartii* from the Pitch Lake, Trinidad.

The Pitch Lake can be described as relatively flat crater that closely resembles a large asphalt car park with pitch folds creating several freshwater pools, furrows and connecting drains. The lake is approximately 0.8km². The perimeter is fringed with marshes and the pools surrounding the lake have several aquatic plants such as lilies (*Nymphaea* sp.) and algae (*Nitella* sp.). Thus far, Kenny (1995) has documented three species of fish for the lake; namely, *Poecilia reticulata* (guppy), *Polycentrus schomburgkii* (Guyana leaf fish) and *Rivulus hartii* (Hart's rivulus). *Rivulus hartii* has the highest density amongst the three species within the lake (personal observations by authors). We have documented pools with fish having mean temperatures of 31.26°C, pH of 4.94, conductivity of 1328 µs and salinity of 0.6‰. During June 2009 a specimen of Hart's

rivulus was collected from the Pitch Lake showing coloration unlike the description above (Fig. 2). After reviewing several pieces of literature on *Rivulus* and Killifish coloration it was determined that this natural color morph is unique. The individual collected is 41mm TL, however, the sex cannot be determined due to the unusual color of the fish. The individual lacks the peduncle spot and seems to have a pink and white hue. Two mottled darker patches are also visible on the dorsal posterior area. The markings along the body are dull orange, only a faint orange band is visible on the caudal fin. With the exception of color, the morphology and attributes of our specimen is in keeping with what can still be taxonomically called a *Rivulus hartii*. When viewed at 4x magnification, minute dots of dark pigment are seen within the scales. No signs of pathology have been

observed. The fish's health, behavior and feeding are the same compared to other *Rivulus hartii* collected at the same time in the lake. During captivity, the specimen was kept in both illuminated and un-illuminated conditions to observe changes in the intensity of coloration. This yielded no change in the fishes' hue or pattern.

Harrington and RIVAS (1958) noted color variation of *Rivulus marmoratus* (collected in Cuba), reflective of the habitat and substrate; light coloration of fish collected in areas of light colored sediments and darker colored fish collected in environments with dark leaf litter substrates. This contradicts our findings for this specimen considering the substrate at the Pitch Lake is mostly black or dark colored. Other *Rivulus hartii* collected within the lake do conform to this adaptation, however (personal observation by authors), but this is temporary with individuals changing color intensity when the substrate is altered.

In Trinidad only the catfish *Rhamdia quelen* has ever shown a color morph in extreme habitat. ROMERO *et al.* (2004) and KENNY (1995) documented several pale catfish in cave systems and their associated drainages in Northern Range of Trinidad. The catfish documented had variable eye diameters and barbell lengths. This reduction in pigmentation and other changes of morphology was attributed to an adaptation to reduced exposure to sunlight; in dark conditions pigmentation is not important. This situation does not occur at the Pitch Lake, as this habitat is exposed to sunlight with little cover by vegetation. Changes in faunal community and individuals within oil impacted habitat have previously been noted (AGARD *et al.* 1993) in marine assemblages. Rather, we hypothesize that due to large natural oil seeps, this habitat is rich in polycyclic aromatic hydrocarbons (PAHs) which are mutagenic and carcinogenic compounds of crude oil. Consequently, one or more loss-of-function mutations may have occurred in the melanin pathway, resulting in the abnormal colour morph. Further investigations into the mutational load of

Rivulus and guppies are warranted to examine the impact of PAHs on the genetics of wild fish populations. Following this we are now seeking explanations our observations. This is the first of a series of our ongoing investigations into the dynamics of the ichthyological fauna of the Pitch Lake.

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