

Anomalous colour in a Cuban cave-dwelling frog: First record of piebaldism in *Eleutherodactylus zeus* (Anura: Eleutherodactylidae)

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ABSTRACT - Pigmentation anomalies may occur due to genetic or environmental factors and can affect restricted parts of the body or the entire surface. *Eleutherodactylus zeus* is frog endemic to western Cuba where it is adapted to life in caves, rock crevices, and other sheltered sites in limestone landscapes associated with forest habitats. We observed 43 frogs in Santo Tomás cave, in Viñales National Park, of which 26 % showed depigmented blotches, typical of piebaldism, along their bodies. No unusual behaviour was detected in any of these frogs. This is the first reported case of piebaldism in frogs of the West Indies and consequently of Cuba. Records of piebaldism in amphibians are very scarce in the literature, not necessarily as a consequence of its rarity in nature but possibly due to inconsistencies in the classification of pigmentation abnormalities.

INTRODUCTION

In spite of their largely nocturnal habits, amphibians exhibit an impressive diversity and complexity in their colour patterns (Hoffman & Blouin, 2000). Amphibian chromatophores are located in either the epidermis or dermis, and they contain pigment granules that vary in chemical composition (e.g. carotenoids, pteridines) resulting in different colours and patterns (Bagnara et al., 1968). However, chromatic disorders occur due to genetic or environmental factors, resulting in pigmentation anomalies that are restricted to a part, or the entire, body surface. Among the main recognised types of pigmentation anomaly are albinism, axanthism, leucism and piebaldism (Bechtel, 1995; Lucati & López-Baucells, 2016). Piebaldism is defined by Lucati & López-Baucells (2016) as “all-white fur/skin patches and eyes normally colored”. It differs from leucism where the entire body is white but the eyes are normally coloured or albinism where there is an unpigmented body with reddish or pink eyes (Lucati & López-Baucells, 2016).

Eleutherodactylus (Syrrophus) zeus Schwartz, 1958 is a frog endemic to western Cuba. It is a cave-dwelling species adapted to life in caves, rock crevices, and other sheltered sites in limestone landscapes associated with forest habitats of the Cordillera de Guaniguanico (Alonso Bosch & Rodríguez Gómez, 2003; Díaz & Cádiz, 2008; Henderson & Powell, 2009). The species has been IUCN listed as endangered because it is restricted to an area of less than 5000 km², its distribution is severely fragmented, and there is continuing decline in the extent and quality of its habitat in western Cuba (Hedges & Díaz, 2004). The Red Book of Cuban Vertebrates (Gonzalez et al., 2012) re-evaluated the conservation status of 61 species of amphibians in Cuba and lists 27 threatened species but failed to include *E. zeus*.

The normal colour pattern of live adults of *E. zeus* (Fig. 1) is an olive brown with a mottled black dorsum and darker brown snout. The upper eyelids of most specimens are clear green. Postscapular spots are yellowish, arms and thighs have lichenous greyish markings. Concealed surfaces of thighs are dull brownish purple, dorsum of thighs mottled brown, tips of dorsal rugosities greenish or yellowish, giving a somewhat speckled and mottled appearance (Schwartz, 1958; Estrada et al., 1986). In this report we document piebaldism in *E. zeus*.

METHODS

As part of monitoring initiative of *E. zeus*, we visited Santo Tomás cave, El Moncada, Viñales, Pinar del Río (22.544496°N, 83.846895°W, WGS 84, 230 m a.s.l.) in April and August of 2017. It is the only large *Eleutherodactylus* species present in this area, and in recent years some natural history observations on this frog have been collected by our team (Alonso Bosch et al., 2007; García, 2012; Alonso Bosch et al., 2015). The cave gallery we visited had a small entrance (2 m high and 4 m wide) that was shaded by the forest so that only limited day light (visible to human eye) reached into the first 5 m of the gallery. Observations were made from the entrance to 220 m inside the cave, during the day (11:00h-14:00h) and night (20:30h-01:00h), using headlamps to locate active animals. When an individual was sighted, it was collected and marked with a unique combination of toe clips (Ferner, 2009) to prevent duplicate counts and afterwards it was released where captured. We paid attention to any unusual behaviour of the animals and their general body conditions. Photo vouchers were deposited in the herpetological collections of the Museo de Historia Natural “Tranquilino Sandalio de Noda” from Pinar del Río, and Museo de Historia Natural “Felipe Poey” from University of Havana, Cuba.



Figure 1. Colour variation in *E. zeus* from Santo Tomás cave, Cuba. Adult male with normal colour pattern (top left), adult female with piebaldism in the loreal area (top right), adult female with the loreal, eyelid, dorsal head, ear and dorsal body areas affected (lower left), and adult male with dorsal and lateral body areas affected (lower right).

RESULTS

We captured a total of 56 *E. zeus* which amounted to 43 unique specimens after correction for repeat captures (Table 1). Eleven of these captures (5 adult females, 3 adult males, 2 adults of uncertain gender, and 1 juvenile) lacked normal colour patterning with depigmented blotches along their bodies (Fig. 1; Table 1). The affected individuals were observed from the entrance up to 120 m inside the cave. Most of the affected frogs were depigmented in more than one area, the head was the most affected area, ten frogs were depigmented in the loreal region, four frogs on the eyelids, three in the dorsal part of the head, and two in the tympanum (Fig. 1). Additionally, two frogs presented loss of pigmentation in the dorsal and lateral areas of their bodies (Fig. 1), and the fore and hind limbs of one frog were also affected. Our observations show a high rate of piebaldism with at most 11 out of 43 individuals (26 %) affected, with no obvious distinction between the sexes. However, no alteration in behaviour was detected in any of these frogs. All individuals were active during both day and night inside the cave, jumping, climbing, or vocalising. No signs of rash, itch, weight loss or fatigue were observed, all individuals were in good physical condition.

DISCUSSION

This is the first reported case of piebaldism in frogs of the West Indies and consequently of Cuba. The piebald condition has been described as an intermixture of a pattern of localised irregular patches with an absence of pigment in an otherwise normally pigmented individual (Acevedo et al., 2009). Records of piebaldism in amphibians are very scarce (Dyrkacz, 1981; Bechtel, 1995; Jablonski et al., 2014), not necessarily as a consequence of its rarity in nature but possibly due to inconsistencies in the classification of pigmentation abnormalities. Nevertheless, piebaldism has been reported in Urodela: *Ambystoma mexicanum*, *Plethodon cinereus* and *Dicamptodon tenebrosus* (Neff et al., 2015) and in Anura it is known from a wild population of *Lithobates catesbeianus* (Whipple & Collins, 1990).

Active individuals have been sighted inside the caves during the day, while at night they usually vocalise from the ground and rocks both inside and outside caves. We found individuals of both sexes outside and inside (at different distances from the entrance) of the cave, with either normal or abnormal colour patterns. Consequently, we consider that darkness does not seem to be a determinant of the frequency

Table 1. Number of *Eleutherodactylus zeus* captured, recaptured and affected by piebaldism, M = males; F = females, J = juvenile, UD undetermined gender

					Recaptures			Affected			
	M	F	UD	J	M	F	UD	M	F	UD	J
April	17	10	0	8	0	0	0	2	3	0	1
August	8	9	2	2	6	6	1	1	2	2	0

of the appearance of piebald individuals. Further studies are needed to clarify the frequency of this abnormality across western Cuba and to evaluate any biological implications that would be negative for the survival of this Cuban endemic cave-dweller.

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