An investigation of color pattern variation in the Tink frog, *Eleutherodactylus martinicensis,* at the Archbold Tropical Research and Education Center in Dominica, West Indies

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Abstract

The Tink frog (*Eleutherodactylus martinicensis*) exhibits a great variety of color patterns, including differences in dorsal patterns and interocular bar patterns. It is unknown whether this variation in color pattern is correlated with body size, particularly in Tink frogs on the Caribbean island of Dominica, West Indies. In this study, 51 individuals of *E. martinicensis* (19.2-39.6 mm Snout/Vent Length, or "SVL") were captured, measured and analyzed to determine if SVL, as a proxy for body size, was correlated with color pattern variations. The collected frogs had variable SVL measurements, ranging from 19.2 to 39.6 mm. However, despite the observed SVL variation, no relationship between color pattern and body size of individuals was detected for the morphs collected where the study was conducted.

Introduction

The genus *Eleutherodactylus* contains 192 species of small ground dwelling and arboreal frogs that are commonly referred to as whistling frogs (Amphibiaweb.org). Members of this genus exhibit a tremendous diversity of color patterns. Even within a single species, color pattern is often highly variable between individuals. One particular study on *Eleutherodactylus guentheri* group focused on categorizing and illustrating intraspecific variation in color patterns on the dorsal surface, interocular bars, pelvic stripes, lip stripes, and tibia stripes (Heyer, 1984).

The Tink frog, *E. martinicensis,* is also reported to exhibit a highly variable color pattern (Malhotra and Thorpe, 1999). Alexander (2007) documented two different color patterns for *E. martinicensis* in Dominica, including a striped form and a plain-bodied form. It is unclear whether the different color patterns exhibited by individuals of *E. martinicensis* are related to size (i.e., ontogenetic change) or sex (i.e., sexual dimorphism).

The purpose of this study was to document color pattern variation in a population of *E. martinicensis* at the Archbold Tropical Research and Education Center (ATREC), and to investigate whether differences in color pattern are related to body size, as an indicator of ontogenic change in individual frogs.

Materials and Methods

Eleutherodactylus martinicensis frogs were collected within the grounds of the ATREC, located off Imperial Road near the village of Canefield, Dominica. Frogs were located at night by using a headlamp while walking around the station. Upon capture, the color pattern of each individual was recorded by photographing the dorsal surface with a Nikon Coolpix S9700. Each individual was then gently placed on its back and measured from the tip of the snout to the vent (snout/vent length, or "SVL") with a digital caliper. After SVL was recorded, each individual was released.

Dorsal color patterns were divided into three different morphs. Individuals belonging to Morph 1 exhibited a solid color on the body (Fig. 1A). Individuals belonging to morph 2 exhibited a stripe running from the snout to the vent along the dorsal midline (Fig. 1B). Individuals belonging to morph 3 exhibited a lighter coloration along the sides of the body than the center of the body along the dorsal midline (Fig. 1C).

Figure 1. The three different dorsal color pattern morphs of Tink frogs identified in this study. **A**. Morph 1, plain bodied individual. **B.** Morph 2, individual with a stripe from snout to vent along dorsal midline. **C.** Morph 3, individual with lighter coloration on the sides of the body than along the center of the body along the dorsal midline.

Figure 2. The two different interocular bar patterns identified in this study. **A.** Morph 1, individual with a dark interocular bar. **B.** Morph 2, individual with a light interocular bar.

Interocular patterns were also divided into one of three different morphs. Individuals belonging to morph 1 exhibited a dark bar between the eyes (Fig. 2A). Individuals belonging to morph 2 exhibited a light bar between the eyes (Fig. 2B). Individuals belonging to morph 3 did not exhibit an interocular bar (not figured). For dorsal patterns, statistical comparisons between morphs were made using the Wilcoxon sign ranked test using the program JMP® v.12.pro.

Results

A total of 51 individuals were collected over 5 nights, ranging from 19.2 mm to 39.6 mm in SVL. Of these, 74.5% exhibit dorsal color morph 1, 21.6% dorsal color morph 2, and 3.9% dorsal color morph 3 (Fig. 3A). For interocular bar patterns, 84.3% of the frogs collected exhibited morph 1, 9.8% morph 2, and 5.9% morph 3 (Fig. 3B).

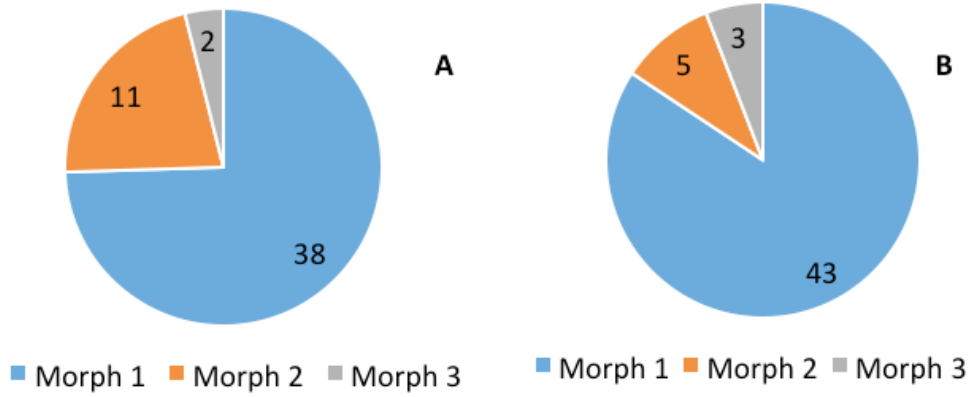

Figure 3. Pie charts showing the percentage of different color morphs for 51 individuals of *Eleutherodactylus martinicensis* collected at ATREC. **A.** Dorsal color pattern morphs. **B.** Interocular bar patterns morphs.

A Wilcoxon sign ranked test revealed a statistically significant difference between the size range of individuals belonging to dorsal color pattern morphs 3 and 1 ($P = 0.0201$; Fig. 5). No significant difference was detected between the size of individuals belonging to dorsal color pattern morphs 1 and 2 or between the size of individuals exhibiting different interocular bar morphs (Fig. 6).

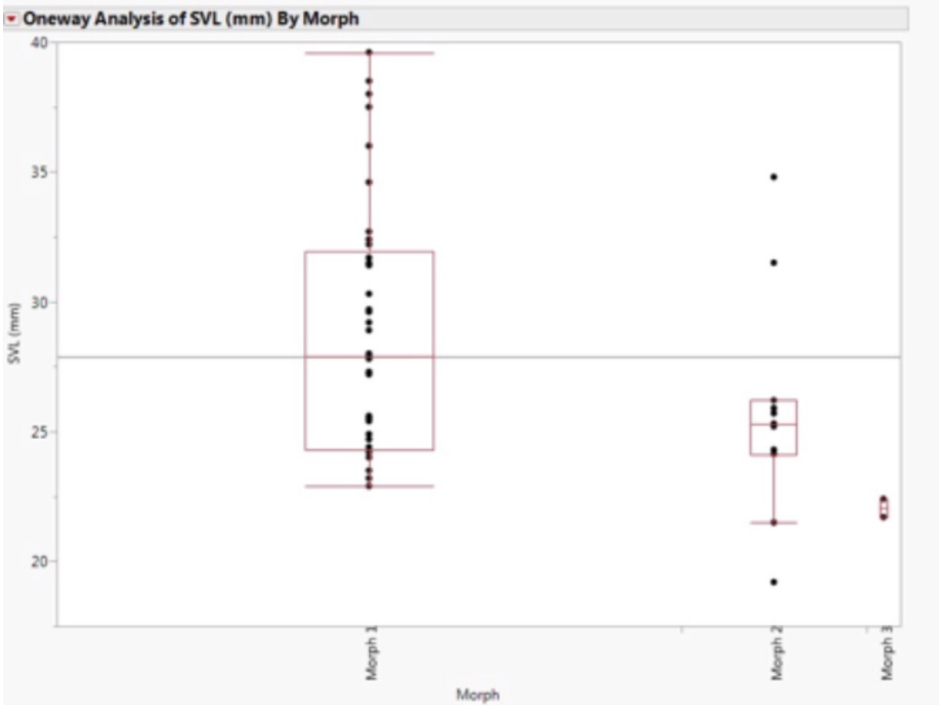

Figure 5. Boxplot exhibiting the statistical analysis of SVL by dorsal pattern for 3 different morphs observed in 51 individual Tink frogs.

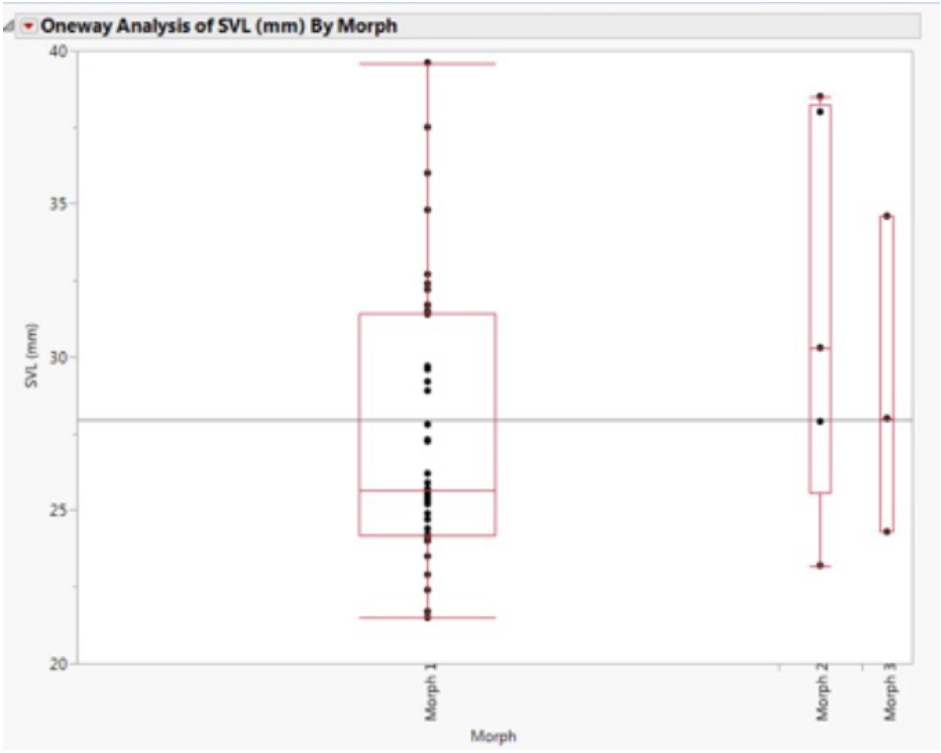

Figure 6. Boxplot showing analysis of SVL by interocular bar pattern for 3 different morphs observed in 51 individual Tink frogs.

Discussion

We found a large amount of overlap in SVL (as a proxy for body size) between all of the Tink frog morphs identified in this study. Though significant, the p-value (0.0201) resulting from the comparison between dorsal color patterns morphs 1 and 3 is likely an artifact of small sample size, especially for morph 3, of which only 2 individuals were collected. These results suggest that different color pattern morphs in *E. martinicensis* are not associated with body size and thus are unlikely to be the product of ontogenetic change.

One crucial piece of information missing from this study is the sex of the individuals collected. Knowing the sex of an individual would allow inferences to be made about whether different morph are the result of sexual dimorphism. Another factor for possible further research is whether or not the calls of individuals belonging to different morphs are different. Also does location, elevation, or temperature have an effect on the abundance of different morphs? Thankfully the Tink frog is one of the most abundant vertebrates on the island of Dominica and answering these questions should not be difficult a task for future researchers.

Acknowledgments

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References

AmphibiaWeb: Information on amphibian biology and conservation. [web application]. 2016. Berkeley, California: AmphibiaWeb. Available: http://amphibiaweb.org/. (Accessed: 26 June 2016).

Heyer, R. W. (1984). Variation, systematics, and zoogeography of *Eleutherodactylus guentheri* and closely related species (Amphibia, Anura, Leptodactylidae). Smithsonian Contributions to Zoology, 402: 1-42.

JMP®, Version 12(pro). SAS Institute Inc., Cary, NC, 1989-2007.

Kristen Alexander, 2007

http://dominica.tamu.edu/student%20projects/Dominica%20Projects%20pdf%20copy/Alexander_Kristen.pdf

Malhotra, Anita and R. S. Thorpe. 1999. *Reptiles and Amphibians of the Eastern Caribbean.* London and Hong Kong: The Macmillan Press Ltd.