THE RELATIONSHIP BETWEEN VOCALIZATIONS OF *ELEUTHERODACTYLUS MARTINICENSIS* AND BODY SIZE

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ABSTRACT

The frog species *Eleutherodactylus martinicensis*, or locally called the tink frog, is a whistling frog native to the island of Dominica, West Indies. The frequency of its vocalizations has been found to fluctuate between individuals. Previous studies on the island of Dominica have shown that the frequency is not affected by temperature, but they are affected by elevation. Even at a constant elevation, the frequencies still shift between individuals. The purpose of this study is to determine a correlation between the frequency of vocalizations of *Eleutherodactylus martinicensis* and the size of the individual. The calls, the snout-vent length, and the weight of 25 individual frogs were recorded. Snout-vent length had no correlation with any part of the call. The weight of the call negatively affected the low frequency of both the second(part B) and third part(part C) of the call. The results of weight affecting the low part of B are inconclusive because part B of the frog calls is a harmonic and it is unclear whether the harmonic was just a factor of the microphone.

INTRODUCTION

Frequently called the “Nature Isle of the Caribbean” for its natural, rich beauty, the island of Dominica rests within the West Indies. Its immense rainforests stretch across the island and within those rainforests inhabit an array of flora and fauna (Evans 1992). The frog species, *Eleutherodactylus martinicensis*, is a whistling frog native to the island. It resides within the rainforests, flourishing in wet areas. The frog is commonly called the tink frog by locals and its recognizable, two note, call can be heard throughout the island. The tink frog’s call is composed of two main parts. The first note of the call is a territorial call to other males and the second note of the call is to attract a mate (Narins and Hurley 1982). The frequency of its vocalizations has been found to fluctuate among individuals. The frequencies have been studied on the island of Dominica by fellow Texas A&M students. Their results have concluded that the frequency of the call is not effect by temperature (Wenner, 2016) and that they are affected by changes in elevation (Ward, 2014). Even at a constant elevation, the frequencies still shift between individuals. A study by

Hoskin in 2009 looked at 116 species of frog in Australia and tested multiple factors regarding the frequency of the frog's calls. One factor tested in particular was body size. Their study came to the conclusion that body size affected the frequency of the frogs' calls. I hypothesize that the variation in the frequency of the tink frog's calls are also related to body size. The purpose of this study is to determine a correlation between the frequency of vocalizations of *Eleutherodactylus martinicensis* and the size of the individual. This will be completed by locating a calling frog, recording the calls, and taking the frog's snout-vent length and weight. The two measurements will then be compared to the high and low frequencies of each component of the tink frog call.

MATERIALS & METHODS

Frogs were recorded and captured after 8:00 pm on clear nights, as rain would damage recording equipment. Data were collected at the Archbold Tropical Research and Education Center (ATREC) and on the trail leading to the Checkhall River. This was done to keep the elevation at a moderately constant 360 meters above sea level. The frogs were located by listening for their calls and following the calls to the individual. Once a visual was made on the calling individual, a AZDEN SGM 1X microphone was used to capture the calls and a Marantz Professional PMD661 digital recorder was used to record them. The microphone was pointed to the calling frog and held six to twenty-four inches away from the individual. The variation of length between the microphone and the frog depending on the gain level on the recorder and the amplitude that the frog was calling at. I recorded for as long as it took for the frog to call at least three times. If a frog was a very active caller, more than three calls were recorded. Once a tink frog's calls were recorded, I captured the frog and placed the frog in a quart sized Ziploc bag. The frog remained in the bag while its measurements were taken. It's snout-to-vent length (SVL) and the frog's weight were measured. The SVL was recorded by flipping the frog on its back and using calipers to measure the SVL to the nearest hundredth of a millimeter. A Pesola spring scale was used to measure the frog's weight in grams. The frog was released after all measurements were taken and recorded. The recorded calls were downloaded from the recorder and were first converted from .MP3 files to .WAV files. The .MP3 file was opened into the program Audacity 2.1.0 and then exported into a .WAV file. This .WAV file then got clipped and went through a simple noise reduction process in Audacity. To obtain the noise reduced file, a selection of background noise was selected, and then “Noise Reduction” was selected from under the “Effect” panel. From the Noise Reduction page, “Get Noise Profile” was clicked. This allowed the program to get a sample of the noise that I wished to be reduced from the file. I then selected the entire file, returned to the Noise Reduction page, and finished the process by clicking “OK” at the bottom of the page. The clipped and cleaned file was then opened in the program Raven Pro 1.5.0. Using spectrograph view, the frequency of the call can be visualized. The call of *Eleutherodactylus martinicensis* can be broken up into three distinct parts. These parts were labelled as A, B, and C as seen in Figure 1. The highest and lowest frequency of each portion of the call was recorded. A Spearman Rank Correlation test was done on the data in Figure 2. The high and low frequencies of each section of the calls was correlated against SVL and the weight of the frogs.

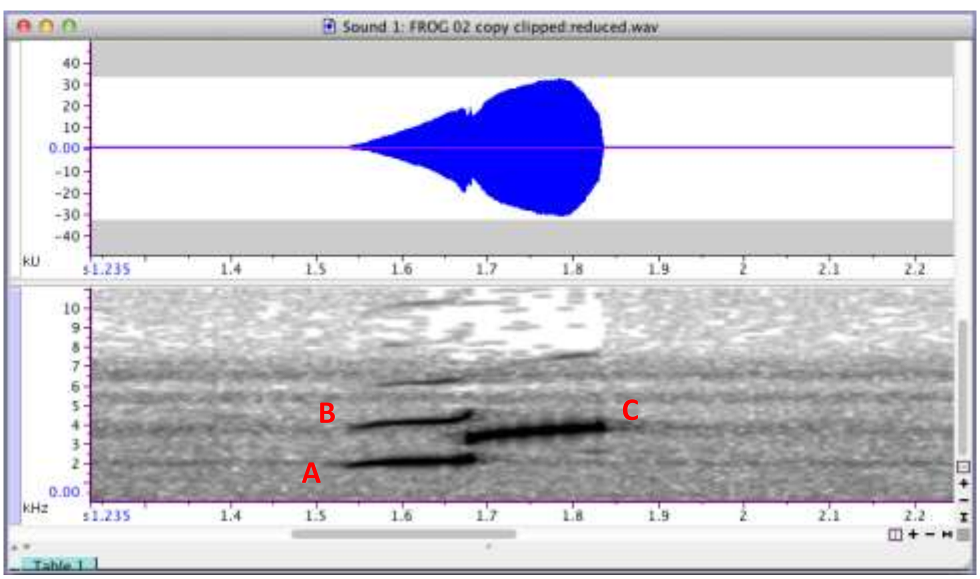

Figure 1. Sample waveform and spectrograph showing a frog call in amplitude and frequency. The parts of the call that were analyzed are labeled A, B, and C.

RESULTS

Over a two-week period, twenty-five frogs were recorded and measured. The frog's SVL ranged from 22.65 mm to 25.71 mm with an average SVL of 23.59 mm. The weight of the frogs ranged from 0.5 g to 2 g with an average weight of 1.07 g. The results of the Spearman's Correlation test are shown in Figure 2. The SVL correlated with frequency did not produce evidence that SVL had any effect on the frequency of the frog's calls. On the other hand, weight correlated with frequency did produce significant results. Low B and Low C had probability (p) values below .05. These low probability values suggest that weight negatively effects frequency. The higher the weight of a frog, the lower the frequency of the section B and C of the call.

SVL vs Frequency		
	Spearman's	P
High A	-0.049	.814
Low A	-0.031	.884
High B	-0.007	.486
Low B	-0.157	.231
High C	-0.002	.993
Low C	0.020	.462

Weight vs Frequency		
	Spearman's	P
High A	-0.030	.443
Low A	-0.221	.114
High B	-0.122	.285
Low B	-0.359	.042
High C	-0.239	.239
Low C	-0.330	.054

Figure 2. Snout-vent length vs Frequency and Weight vs Frequency Spearman's Correlation test results. The probability values of Low B and Low C correlating with weight are close to or below .05, suggesting that Low C and Low B that the heavier the frog, the lower frequency of the third part of the specified part of the call.

DISCUSSION

Example calls in Figures 3 and 4 show the frequency difference between the calls of frogs with a higher weight and a lower weight. Figure 3 shows FROG 12, weighing 1.2 g, had a Low B of just over 3500 Hz and a Low C of about 2600 Hz. FROG 18 in Figure 4 only weighed 0.75 g, .45 grams smaller than FROG 12. It had a Low B of about 4000 Hz and a Low C of 3000 Hz. As seen by the Spearman's Correlation test, the trend of the higher the weight and the lower B and C can be shown in these two figures. One

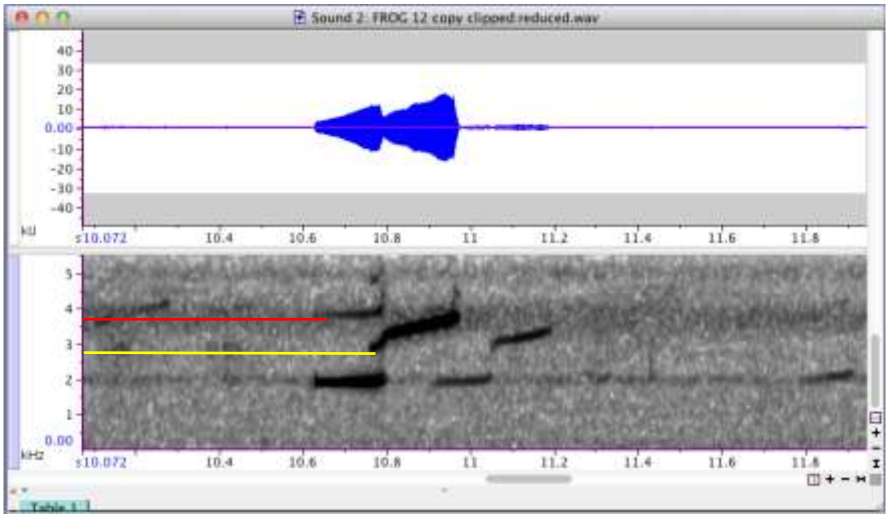

Figure 3. Example call of frog 12, who weighed 1.2 grams. The red line shows the frequency of the Low B, while the yellow line shows the frequency of Low C.

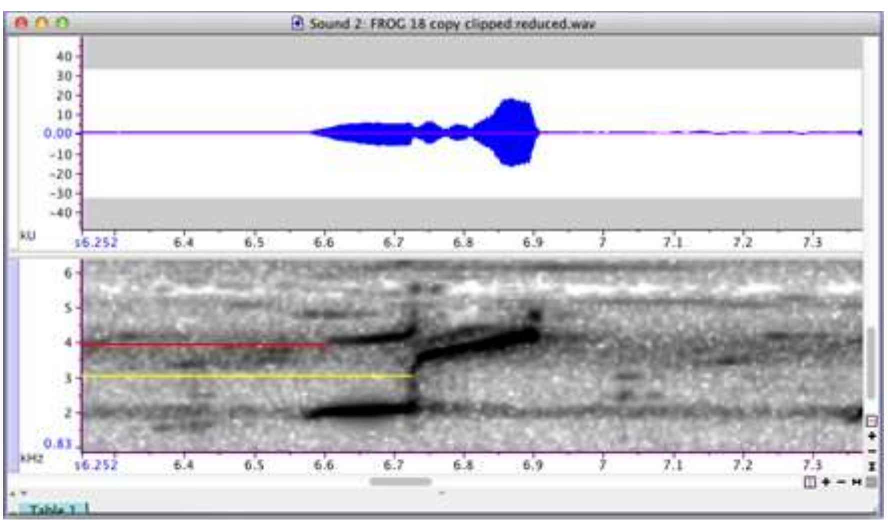

Figure 4. Example call of frog 18, who weighed 0.75 grams. The red line shows the frequency of the Low B, while the yellow line shows the frequency of Low C.

reason why part A of the call was not effected by either SVL or weight, may have been because part A of the frog call may be used for territorial reasons, as it is in a similar species, *Eleutherodactylus coqui*. Part C of the call is what is used by the frog to attract a mate, it is the section of the call that tells the females about the male that is calling (Narins and Hurley 1982). Part C was the most variable section of the call. Since weight only effected the lowest point of part C and no other parts of C, future research is needed to find the factor behind the frequency variation in part C. Factors that may be affecting the frequency are distance from water sources and density of males. The males also seem to call individually and in rapid, short bursts. These short bursts may be in response to other males. It is possible that depending on the males around them, they change their calls in response to competition, as in some cricket frogs. (Ryan and Wilczynski 1991)

Although the test provides evidence that the weight of the frog effects the low frequency of B, these results are inconclusive. The recordings that I received are the first to show part B, a harmonic of part A. This harmonic was present in 92% of the calls that were recorded. There is uncertainty in how the harmonic was produced. The call may have been reflecting off vegetation or the ground. Therefore, more research can be done to identify the source of this harmonic. Microphone angle and the local environment around the frog could be studied and compared with the harmonic received.

While I was collecting field data, I noticed that the tink frogs made another call. When one frog would make this call, the call would spread and other frogs would replay with the same call in return. Silence would then follow the string of calls. I eventually was able to capture a recording of this call. The recording is pictured in Figure 5. Here, the frog made the call twice. The frogs made a small blip which was then followed by 5 quick chirps. The reason the frogs make this call is unknown. I speculate that this is a warning call. Whenever I would hear this call, it would be when I was walking and shining my headlamp around. Silence would follow and no frog would call for a minute or two. I also believe it may be a warning call because the call seemed to be passed around. Multiple frogs would echo the call before all the frogs got quiet. A project could be done to test this theory and find out the meaning behind the call.

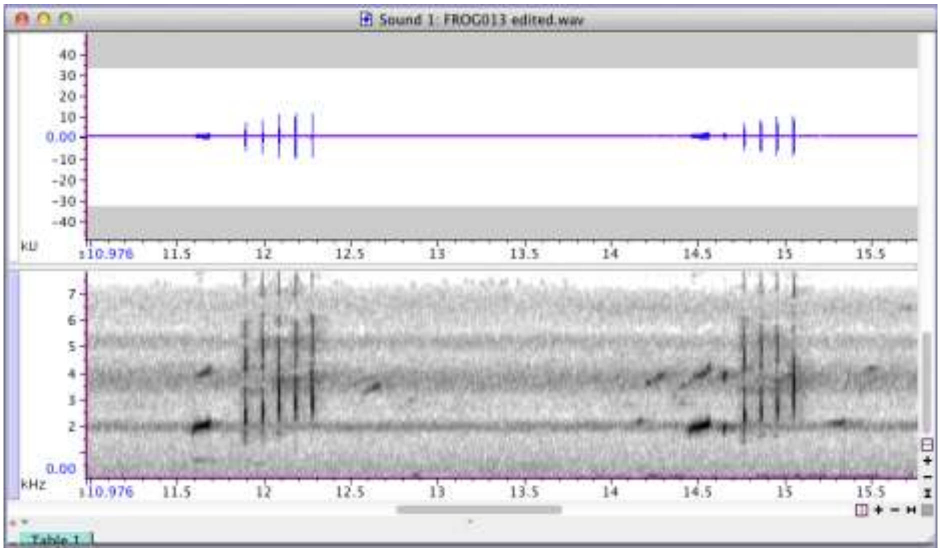

Figure 5. Spectrograph view of the frog call with an unknown meaning.
The small call before 5 quick calls can be seen clearly.

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CITATIONS

Casillas, G. Soundscape Ecology of Tink frogs. (2013). http://dominica.tamu.edu/student%20projects/Dominica%20Projects%20pdf%20copy/Casillas_Gaston_2013.pdf

Evans, P. (1992). Birds of the Eastern Caribbean. London: MACMILLAN PRESS LTD. Honeychurch, Lennox. Dominica: Isle of Adventure: An Introduction and Guide. MacMillan Education LTD, London and Basingstoke, Third Edition. Pp. 1-3

Hoskin, C. J., James, S., & Grigg, G. C. (2009). Ecology and taxonomy-driven deviations in the frog call–body size relationship across the diverse Australian frog fauna. *Journal of Zoology*, *278*(1), 36-41.

Kaiser, H. (1992). The Trade-Mediated Introduction of Eleutherodactylus martinicensis (Anura: Leptodactylidae) on St. Barthélémy, French Antilles, and Its Implications for Lesser Antillean Biogeography. Journal of Herpetology, 26(3), 264-273. doi:10.2307/1564880

Narins, P., & Daniel D. Hurley. (1982). The Relationship between Call Intensity and Function in the Puerto Rican Coqui (Anura: Leptodactylidae). Herpetologica, 38(2), 287-295.

Ryan, M. J., & Wilczynski, W. (1991). Evolution of intraspecific variation in the advertisement call of a cricket frog (Acris crepitans, Hylidae). *Biological Journal of the Linnean Society*, *44*(3), 249-271.

Ward, W. (2014). An Analysis Of *Eleutherodactylus martinicensis* Vocalizations As A Function of Rainforest Elevation Modifications. http://dominica.tamu.edu/student%20projects/Dominica%20Projects%20pdf%20copy/Ward_Whitney_2014.pdf\.