An Analysis Of *Eleutherodactylus martinicensis* Vocalizations As A Function of Rainforest Elevation Modifications

Whitney Ward

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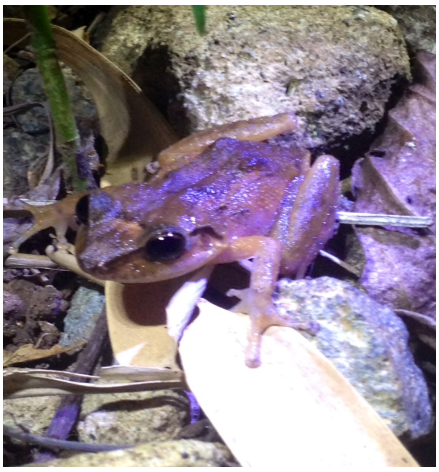
Dr. James Woolley, Dr. Thomas Lacher

Department of Wildlife & Fisheries Sciences

Texas A&M University, College Station, TX, USA 77843



Abstract

The objective of this study was to discover whether the habitat of *Eleutherodactylus martinicensis*, specifically forest elevation variation, has an influence on the pitch of their distinctive communicating calls. Each of the frog calls was recorded using a Marantz PMD660 digital sound recorder along with a Shure 4.0 condenser microphone. The data were collected from a multitude of rainforest habitats with a range of elevations to include Soufriere Park, Springfield Field Station, Emerald Pool, and Middleham Falls. The data supported the scientific hypothesis, which stated Tink frog vocalizations would change frequency and pitch with increasing elevation from sea level. The trend shows that *E. martinicensis* on the island of Dominica have higher call frequencies in lower elevations and with a gradual increase in elevation, the frequencies of the call decline.

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Introduction:

Dominica is found within the lesser Antillean islands of the Caribbean and has a noticeably abundant variation of habitats incorporating rain forest, coastal thicket, dry forest, and elfin cloud forest (Evans, 1992). Because bird richness dominates vertebrate diversity of the island, the rest of the ecosystem is rather constrained for smaller mammals (Honychurch, 1998). Along with majestic flora, the island also possesses a significant number of species of amphibians and reptiles. *Eleutherodactylus martinicensis,* commonly referred to as "Tink Frog" in Dominica, is a species of frog that inhabits and is endemic to the Lesser Antilles islands of the Caribbean.

These anurans are observed in tropical habitats and fluctuate in size depending on gender. Commonly referred to as the Tink frog in Dominica, this amphibious creature is nocturnal with a distinctive black marking behind its eye. This frog is also active year round. Communication plays a vital role in the behavior of most anuran amphibians. Tink frogs may communicate using high-pitched whistle-like sounds in order to defend one's territory via counter calling or to attract a mate.

E. martinicensis possess a relatively homogenous vocalization call in the rainforest, but frogs may have adapted their calls according to the surrounding environment at different elevations. This study was designed to investigate whether *E. martinicensis* individual vocalization calls would alter pitch and frequency as a result of inhabiting habitats at different elevations. My hypothesis was that *E. martinicensis* calls

would produce a higher pitch as well as frequency at lower elevations as opposed to higher elevations. Lower elevations on the island are the most prominent place for civilization. With this, it can be assumed that the vocalizations from lower elevations may have higher frequencies because of their proximity to urban environments, competition with noise pollution, and the greater amount of human interactions. In higher elevations, air pressure drops and frequencies may also drop because there are fewer noise disturbances and less competition for communication between one another, be it for mating or territorial defense.

Materials and Methods

A field study was conducted over one week at Dominica, located in the West Indies. Data were collected nightly between the dates of May 23rd and June 4, 2014 at the Archbold Tropical Research and Education Center (ATREC), Emerald Pool, Middleham Falls, and Soufriere Park. Soufriere Park is geographically positioned at an altitude of 22 meters, ATREC is at an altitude of 360 meters, Emerald Pool is at an altitude of 542 meters, and Middleham Falls is at the highest observed altitude of 702 meters.

Employing headlamps to light the trails after dark, recordings were saved on a Marantz Professional PMD660 digital recorder utilizing a Shure BG 4.0 microphone. The objective in the field was to record ample amount of clean *E. martinicensis* calls in order to search for a possible trend between differences in habitat elevation and call frequency. Because the Shure microphone is highly directional, it was held in the direction from which the majority of the frog call's pitch was heard from.

At each location, between 15 and 30 samples were collected depending on the vocalizations of nearby amphibians. These recordings were filtered, examined, and processed at ATREC on a MacBook Pro laptop. After connecting the Marantz recorder to the computer, the sound was then fed through Audacity software, where the initial clearance of bad recordings came into effect. Further more, the selected recordings were saved into a main file entitled "Frog Calls 2014." With RavenPro version 1.4 the sound files were clipped for the elimination of background noise from interfering with the call itself to ensure a more accurate pitch. By grabbing one call from the file, copying, and pasting it into a new sound window, it becomes possible to obtain the high and low frequency of one single frog call.

Results

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1408180.615	1	1408180.615	94.763	.000[b]
	Residual	564681.785	38	14860.047		
	Total	1972862.400	39			

a. Dependent Variable: Elevation

b. Predictors: (Constant), Frequency

Table 1: The test of significance of the linear regression model.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.845[a]	.714	.706	121.902

a. Predictors: (Constant), Frequency

Table 2: According to the data and calculated Model Summary, R square is valued at 0.714. R square explains that there is a 71.4% variation in frequency (Hz) thus explained by elevation.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2771.200	237.198		11.683	.000
	Frequency	-.571	.059	-.845	-9.735	.000

a. Dependent Variable: Elevation

Table 3: Frequency = -0.571 (elevation) + 2771.2

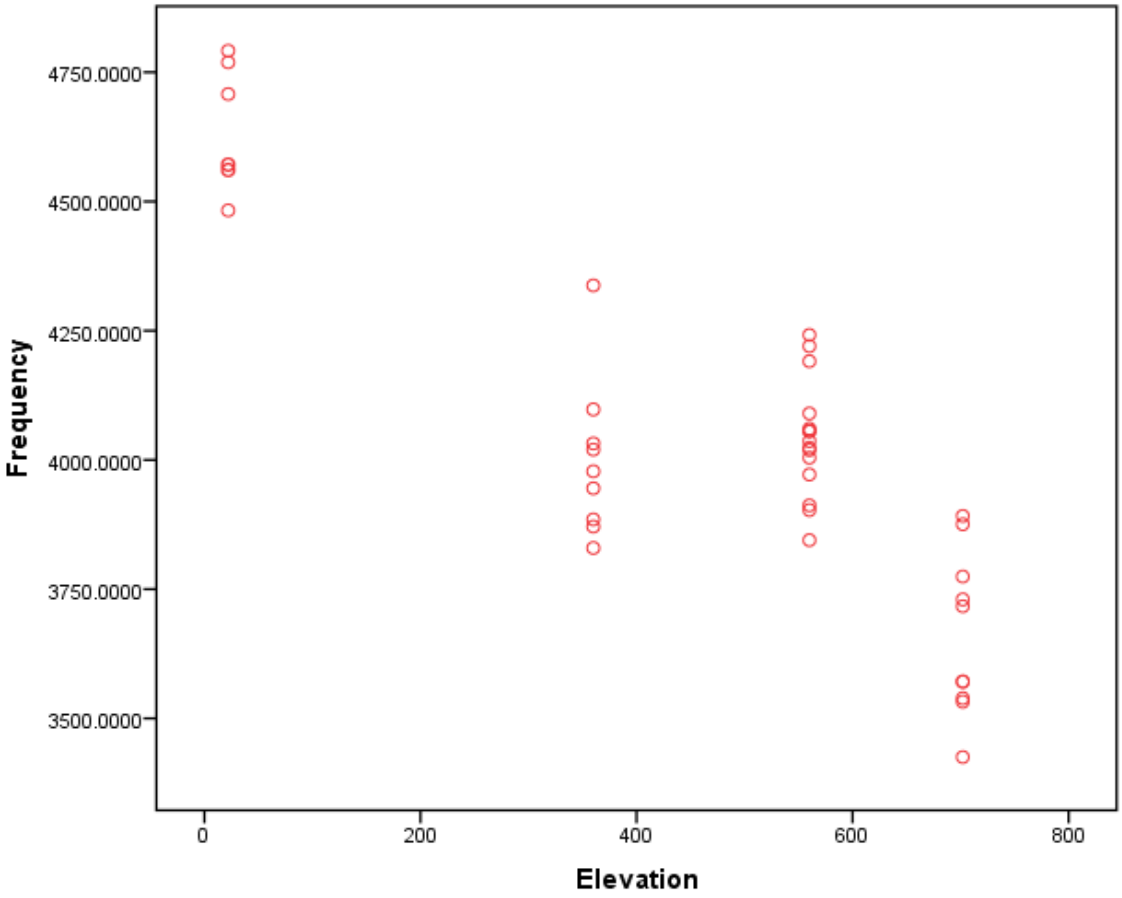

Figure 1: Negative regression between *E. martinicensis* calls frequencies (Hz) and forest elevation (m).

Dependent Variable: Frequency

Elevation	Mean	Std. Deviation	N
22	4647.266667	126.2239544	6
230	3999.533333	153.0346366	9
542	4041.966667	113.1473923	15
702	3662.76	157.4807233	10

Table 4: Mean frequency values (Hz) at corresponding location elevation.

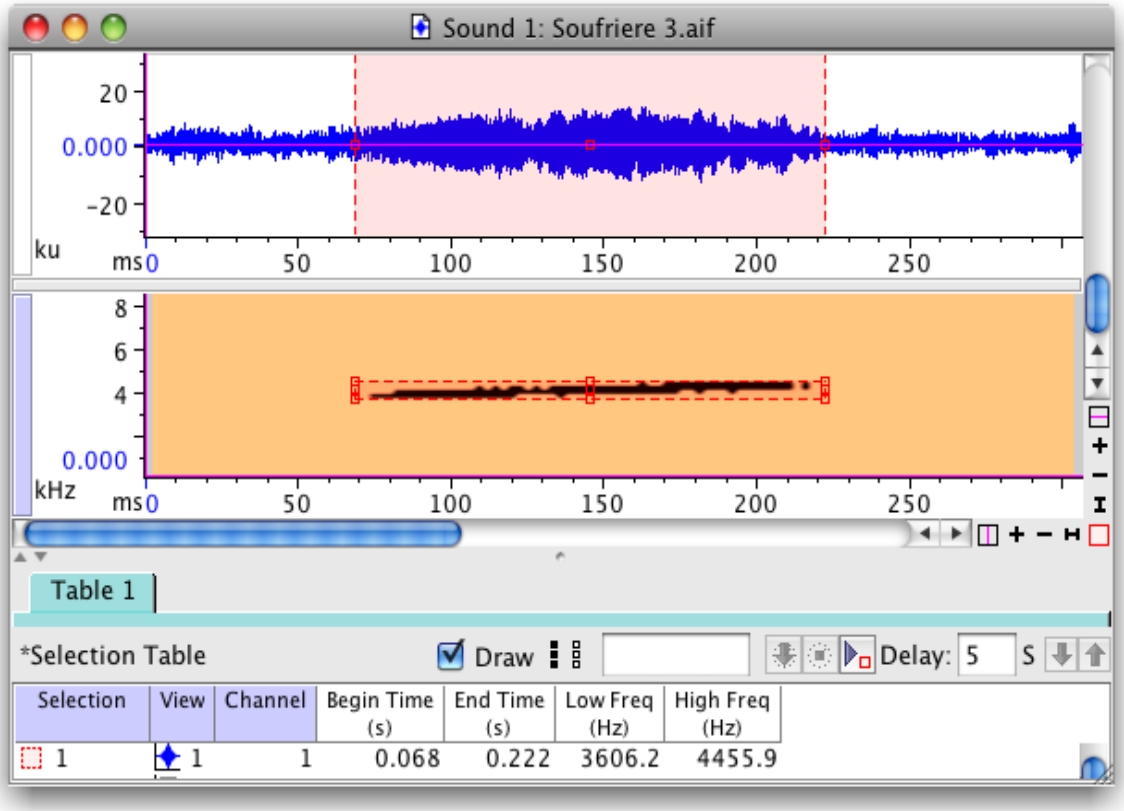

Figure 3: High frequency of *E. martinicensis* call recorded at Soufriere Park was approximately 4455.9 Hz.

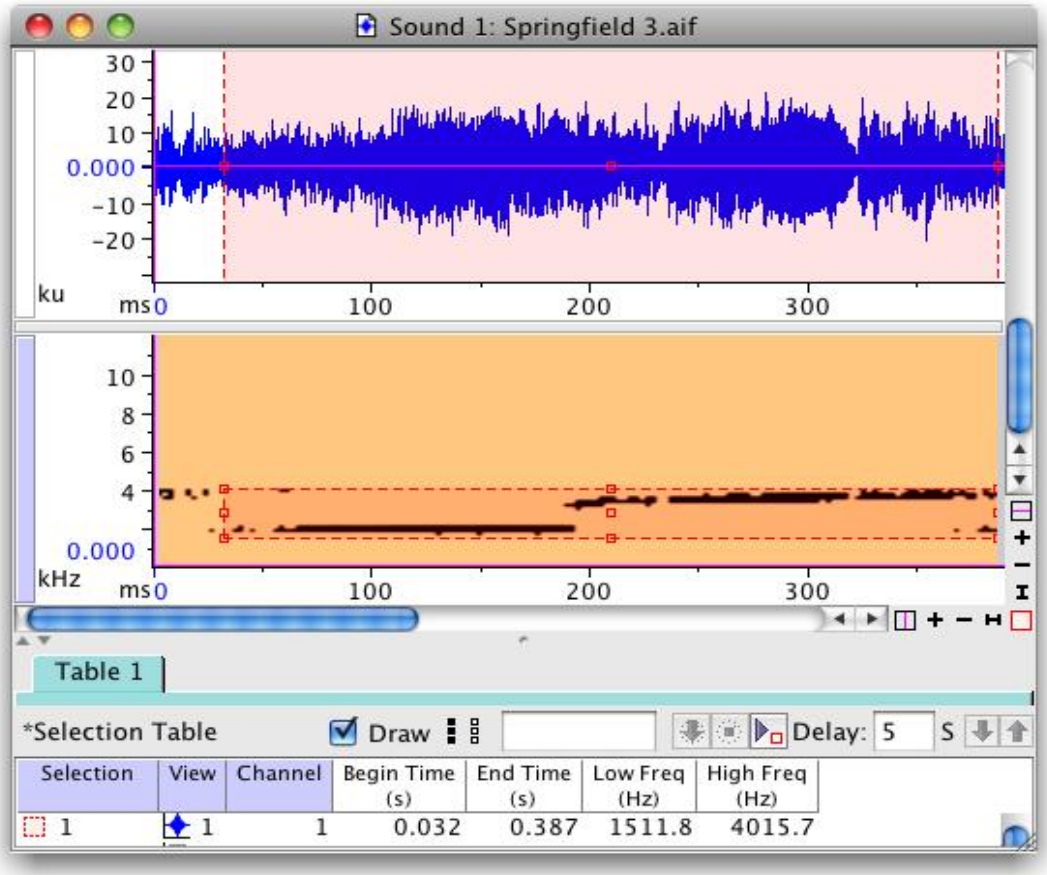

Figure 3: High frequency of *E. martinicensis* call recorded at ATREC was approximately 4015.7 Hz.

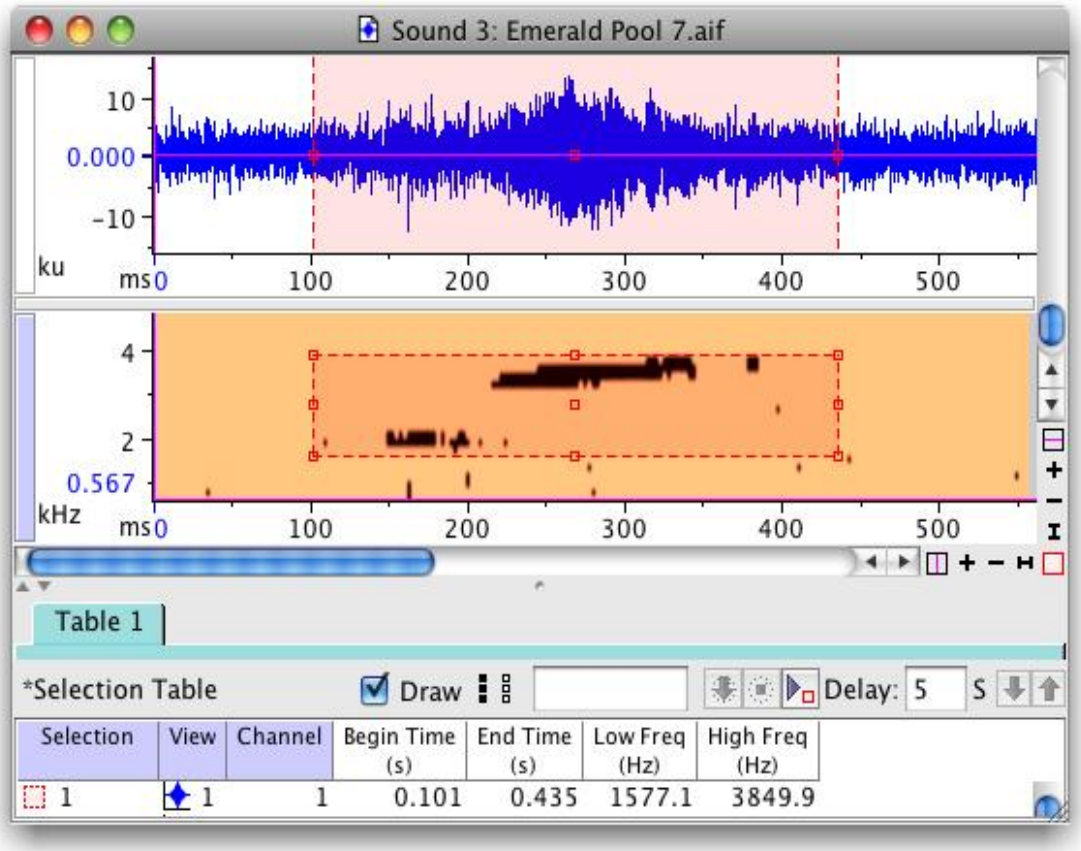

Figure 4: High frequency of *E. martinicensis* call recorded at Emerald Pool was approximately 3849.9 Hz.

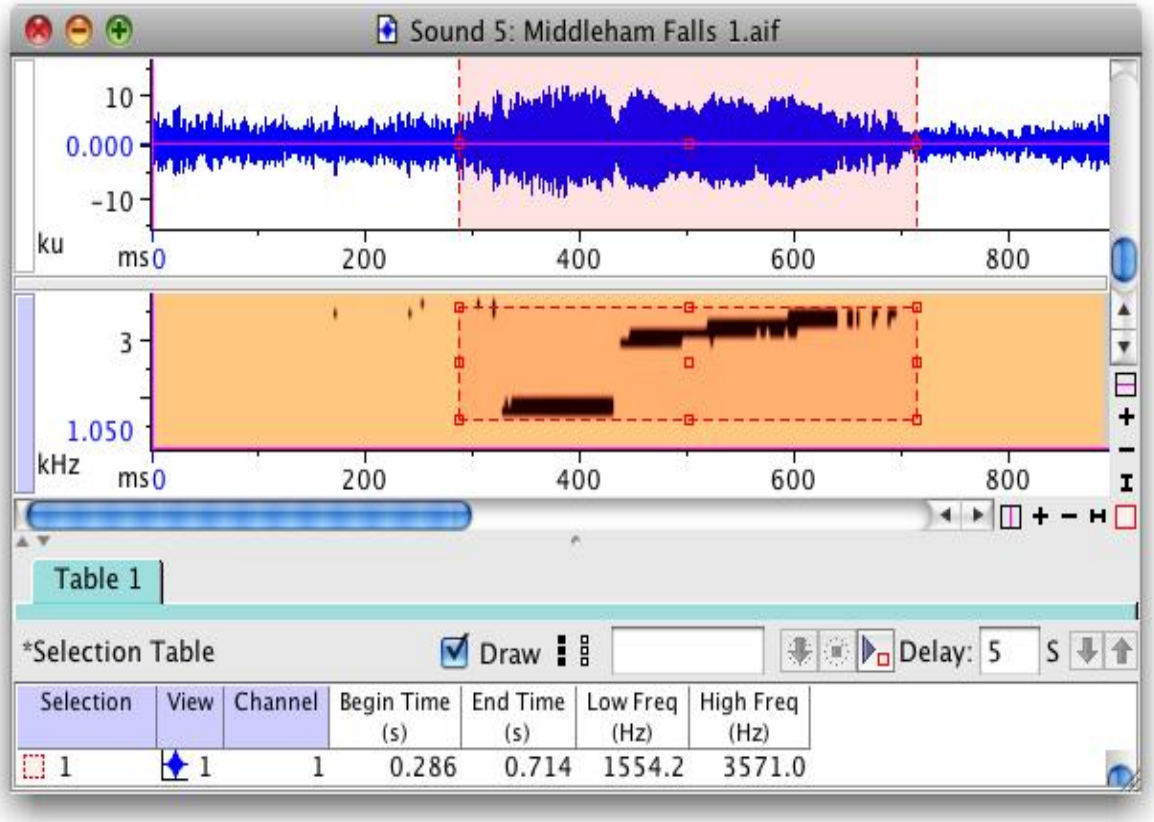

Figure 5: High frequency of *E. martinicensis* call recorded at Middleham Falls was approximately 4015.7 Hz.

Discussion

A number of *E. martinicensis* calls were recorded nightly from four sites at distinctly different elevations during the week of data collection. Beginning at sea level, recordings were gathered from Soufriere Park (22m), ATREC (360m), Emerald Pool (542m), and Middleham Falls (702m). An average of the call frequencies was calculated to give an estimate for the relative frequency pertaining to the specific elevation. Whilst frogs recorded from Soufriere Park near sea level obtained the highest frequency of about 4791.7 Hz, frogs from Middleham Falls, at a much higher elevation, obtained the lowest frequency of about 3844.7 Hz.

Further evidence supports the hypothesis that the variation of pitch and frequency of Tink Frog calls in Dominica can by interpreted by elevation. Corresponding statistical analyses show that with an R square value of 0.714, there is a 71.4% variation in frequency (Hz) explained by elevation. Calls from Middleham Falls at 702 meters altitude had even lower average frequencies than those recorded from Emerald Pool at 542 meters altitude.

The average frequency table shows an unmistakable increase in the sample size from lower elevations to higher elevations. At Soufriere Park, just above sea level, it was rather challenging to hear single frog calls over the dogs barking and the motorized vehicles speeding by. As a matter of fact more than enough data was obtained from Emerald Pool and Middleham Falls located at much higher altitudes. *E. martinicensis* were within feet from the microphone, providing ample opportunities to record as well. The purpose of this study was to investigate whether Tink Frog vocalizations from lower elevations have higher frequencies than those in higher elevations. Data from the field

supports the hypothesis, but poses uncertainty that may be explained by the frog's proximity to urban environments, and competition with noise pollution. Another study could be conducted to analyze if the vast majority of urban noises coming from lower elevations explain the reason *E. martinicensis* vocalization frequencies are also higher in that altitude. This may be accomplished by including more recordings from lower elevations nearby or within an urban civilization. Additional analyses need to be directed towards a variety of lower altitudes, i.e. 15, 25, 50, and 100 meters above sea level. It may be useful to record near urban noises at those lower elevations and directly compare that data with recordings from higher rainforest habitat.

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