Vocalizations of the frog *Eleutherodactylus martinicensis* in relation to temperature

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Abstract

The Tink frog, *Eleutherodactylus.martinicensis*, is a whistling frog that inhabits several ecosystems throughout the Lesser Antilles of the Caribbean. Male frogs of this species produce a distinct call in order to attract a female. To date, no information has been recorded on the characteristic vocalization frequencies of Tink frogs with respect to body temperature in Dominica. In this study, twenty-five vocalizations produced by *E. martinicensis* frogs were captured and analyzed, in order to determine whether the highest, lowest, and average call frequencies varied with respect to body temperature. It was concluded that temperature does not affect call frequency. However, it was discovered that the beginning segment of the call tended to always reach the same frequency, while the end-tail frequency of the call varied.

Introduction

The Tink frog (*Eleutherodactylus martinicensis*) is a whistling frog that inhabits the Caribbean islands of Antigua, Barbuda, Guadeloupe, Martinique, and Dominica (Massie, 2008). In Dominica, these frogs can be found throughout wet regions of the island. As these frogs are vastly spread, they play an important role in many regions of the Nature Island's unique ecosystem. They have been recorded as a natural predator to disease carrying mosquitoes, other arthropods, and as indicators of a changing environment (Stolz 2015).

During the heat of the day Tink frogs hide under rocks or in brush in order to avoid predation. At night, these nocturnal animals come out of their burrows and begin to call actively after rain or when the temperature on the island begins to cool down slightly. Male frogs will call to females in hopes of attracting a mate (Lemon, 1971). Previously studies by Texas A&M students on Tink frog vocalizations concluded that shifts in elevation (Ward, 2014) and the density of the soundscape (Casillas, 2013) affected the frequency of frog calls. The purpose of this study was to continue to explore factors regarding the differences between changes in Tink frog call frequency on Dominica, like body temperature.

Materials & Methods

Tink frog vocalizations were recorded around the grounds of the Archbold Tropical Research and Education Center (ATREC), as well as on the trail leading to the Checkhall River in order to keep the elevation relatively constant (360 meters above sea level). The calls were captured either after dinner, roughly after 8 pm, or when it rained and they were actively calling. Vocalizing frogs were located by call and their emitted sounds were recorded with a Marantz Professional PMD660 digital recorder. Sound recordings were obtained within a one-meter radius of a vocalizing individual. The body temperature of the vocalizing individual was measured using a SPER Scientific IR Thermometer Gun 800103.

Sound recordings were clipped and clarified using Audacity 2.1.2. Using a spectrograph view, we removed from the recording other background calls, such as those of bugs and geckos. Clarified recordings were then further analyzed in Raven Pro 1.4 in order to find the peak frequency of each call. Using Raven, each clip was cut into as many 0.01-second bits as possible. Each of these segments was assigned a peak frequency (shown in Figure 1, in green). They were then averaged into different categories. As each call had two evident segments, the two sound components were catalogued in the results as the "lower average" frequency, the "higher average" frequency, and the overall "average" frequency. Peak frequencies were then compared using simple regressions between frequency and body temperature of the frog. These regression lines were then laid on figures to show the trends between variables.

Results

Twenty-five frog calls were recorded over a three-week period. Call frequencies ranged from 1550.4 to 4306.6 Hz over a 5.3˚F range in body temperature. A sample call and sound spectrograph of a Tink frog ("Springfield 15") is shown in Figure 1. This frog produced a call with an average frequency of 2829.3 Hz and had a body temperature of 71.3˚F when the call was recorded. The average frequency recorded for beginning segment calls was 1937.1 Hz, and showed no evident correlation between the highest frequency of calls and body temperature (Figure 2). The lowest average high frequency was similar across all sampled individuals, showing no a correlation value close to zero, thus suggesting no correlation of lowest average frequency with body temperature. Finally, the overall average frequency with relation to temperature showed an R^2 value higher than those of either the highest or lowest average frequencies (Figure 4). However this correlation value was still less than 0.1 and thus could not be used to prove a correlation between overall average frequency and body temperature.

Discussion

Results clearly showed that the frequency of the call was independent of the temperature of the frog. As shown in all three figures, the regression lines resulted in a value close to zero. Thus, body temperature was eliminated as a factor in influencing call frequency.

However, an interesting trend was noticed in the analysis of high and low average frequencies. The calls of Tink frogs recorded in this study comprise two distinct segments, including a first and second segment. The tone of the first (or lower) segment is consistently lower than that of the second (or upper) segment. While entering data into a table it was discovered that the lower region of the call hits 1894.9 Hz for a few seconds, regardless of where it begun or ended, in all 25 calls. A red line showing the cluster of 12 of the 25 calls (48%) averaged around 1894.9 Hz (Figure 2). In comparison, the higher average frequency tended to be much more variable with no clear repeating frequency. This may indicate that the different segments of the call serve different functions. Perhaps the first segment of the call is used to catch the attention of a potential mate while the second segment is used to attract a mate.

Future studies could be conducted in order to measure how the individual segments of a Tink frog call vary over differing elevations. As shown by previous studies, call frequency averages are influenced by elevation and soundscape. Investigation into how the individual segments vary among these could further concrete which of the two ideals are more influential.

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Figures

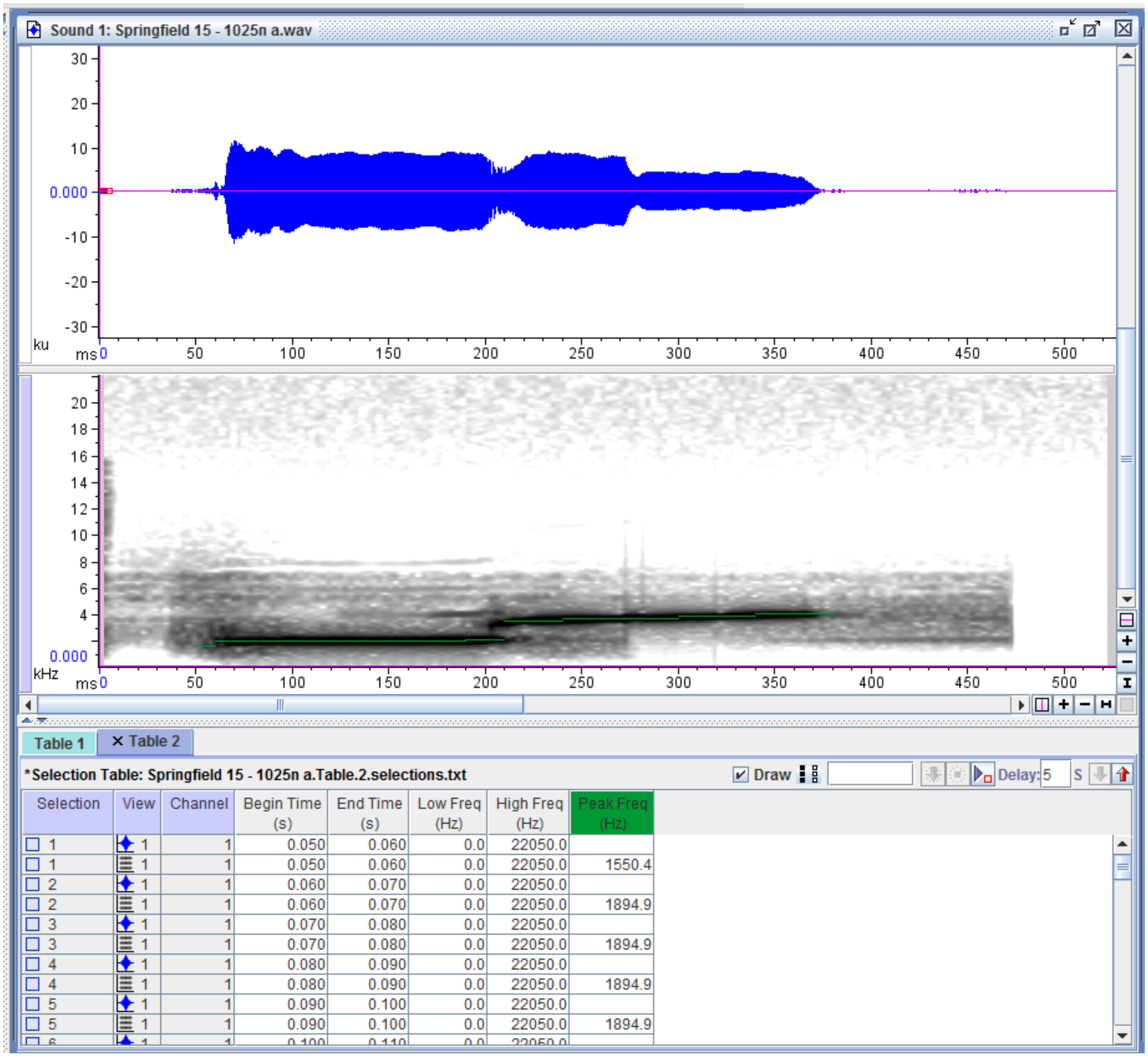

Figure 1. Sample sound spectrograph of a tink frog ("Springfield 15") call taken west of the Springfield station. This frog produced a call with an average frequency of 2829.3 Hz and had a body temperature of 71.3˚F when the call was recorded.

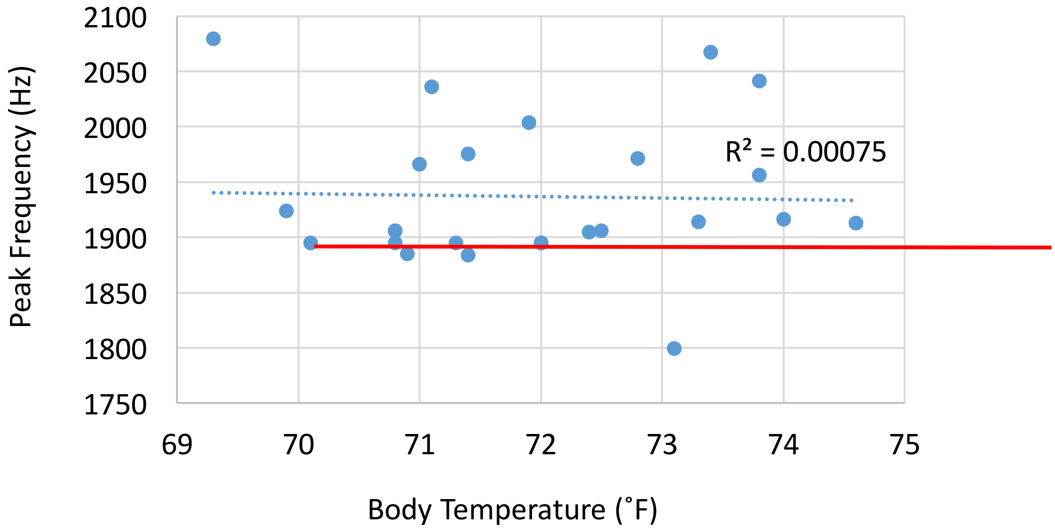

Figure 2. Average lowest frequency vs. temperature of Tink frogs recorded in Dominica. The red line indicates the average peak frequency recorded (1894.9 Hz). 12 of 25 (48%) of the calls cluster around this line. This illustrates that the first segment of the call may be used to catch the attention of a potential mate. The low R^2 value indicates a low correlation coefficient between peak frequency and body temperature.

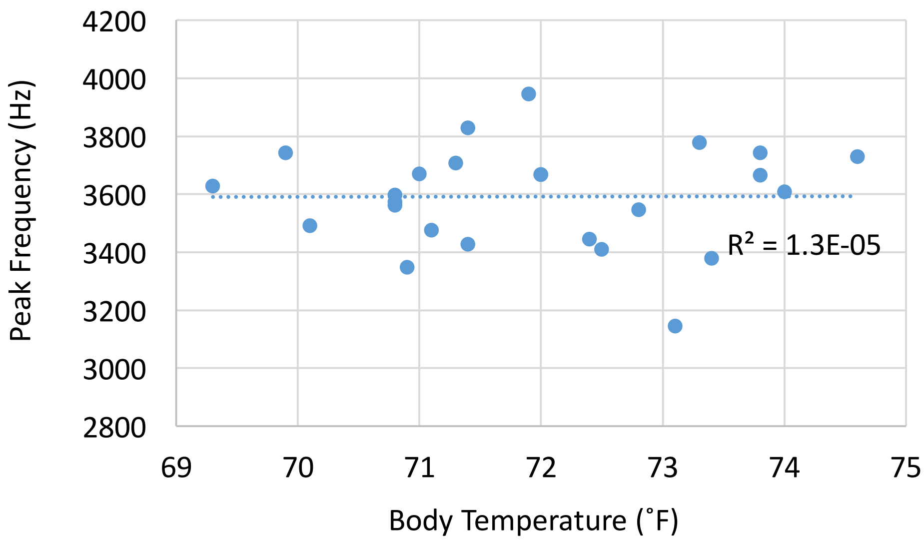

Figure 3. Average highest frequency vs. temperature of Tink frogs recorded in Dominica. The low R^2 value indicates a low correlation coefficient between peak frequency and body temperature.

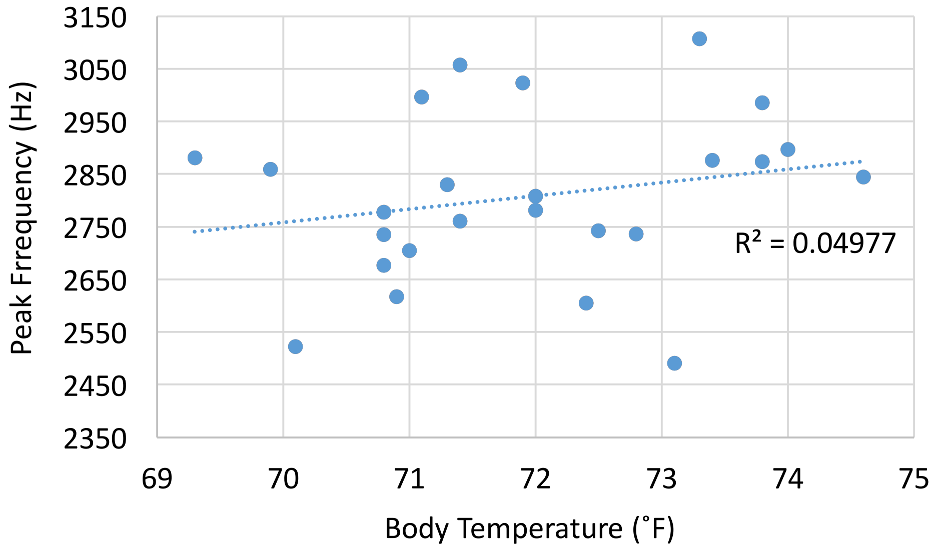

Figure 4. Overall average frequency vs. temperature of Tink frogs recorded in Dominica. The red line indicates the average peak frequency recorded (1894.9 Hz). The R^2 value indicates a slight positive association between overall average frequency and body temperature.