

**Intraspecific and Interspecific Comparisons of  
Frog Vocalizations on Dominica**

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May/June 2008

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## ABSTRACT

Vocalizations play a central role in frog behavior. Quality recording equipment and Raven software were used to view and compare the spectrograms of three different species on Dominica. Intraspecific and interspecific correlation coefficients were calculated and analyzed to better understand the differences between how these species communicate. As expected, intraspecific vocalizations were most highly correlated, followed by frogs of the same genus. The lowest correlation coefficient was between frogs that were not of the same genus.

## INTRODUCTION

There are four different frog species present on the volcanic island of Dominica, all belonging to the family Leptodactylidae. These include *Eleutherodactylus martinicensis*, *Eleutherodactylus amplinympha*, introduced *Eleutherodactylus johnstonei*, and *Leptodactylus fallax*. Dominica has significant geographic and biological variation, including scrub woodland, montane forest, rain forest, elfin woodland, littoral woodland, swamps and marshes. This analysis focuses on primary and secondary forests, the latter being the result of agriculture practices and clearing.

*Eleutherodactylus* is the most speciose vertebrate genus in the world, two species of which occur on Dominica. *E. martinicensis* (Figure 1) is the most abundant of the whistling frogs on the island. With females having a 47mm SVL, *E. martinicensis* is large for a whistling frog, with a great deal of color variation and dorsal patterning. The call of this species has two parts. The males let out a short level note followed by a longer rising note used primarily to invite females to mate. A series of rapid clicks may be used to communicate with other males, often occurring at the beginning and end of a calling period.

The other whistling frog, *E. amplinympha* (Figure 2) is endemic Dominica, is less abundant and found at higher elevations, generally in montane or elfin forests. It is the largest species of this genus and also displays much color and pattern variation. The primary morphological distinction between this frog and *E. martinicensis* is that the inner toes on its front feet are the same size while the fourth toe of *E. martinicensis* is longer. The three-part call of *E. amplinympha* may also be used to distinguish between the two species, with an additional note at the end of the rising whistle. Both species use similar rapid clicking to communicate with other males.

*E. johnstonei* is presumed to have been introduced to Dominica in 1979 when relief supplies were sent to Dominica following hurricane David (Clarke 2008). Experts have been concerned about the impact this potentially invasive species may have on the endemic species.

Commonly known as the mountain chicken because of its use in the food industry, *L. fallax* is a large frog with females having a 17mm SVL. These nocturnal frogs have a loud whooping call occurring at about one minute intervals, which is likely used for territorial reasons. *L. fallax* is found on the western side of Dominica in natural forests and agricultural areas up to altitudes of 300m (Malhotra 47).

Male frogs are highly vocal amphibians, equipped with vocal chords to produce sound and air-filled vocal sacs for amplification. Calls may be used to attract females as well as in territorially

defense toward other males. Environment may play a role in the adaptation of calls, which tend to be species-specific (Malhotra 3). The role of terrain and vegetation in frog communication, as well as the immense environmental variation on Dominica, led to the development of this research. This experiment investigates the intraspecific correlation between *E. martinicensis* vocalizations in primary and secondary rainforest habitats, the interspecific correlation between *E. martinicensis* and *E. amplinympha* vocalizations, and the interspecific correlation between *E. martinicensis* and *L. fallax* vocalizations.



**Figure 1.** *Eleutherodactylus martinicensis* (Photo from <http://www.faune-guadeloupe.com>)



**Figure 2:** *Eleutherodactylus amplinympha* (Photo from <http://www.oas.org>)



**Figure 3.** *Leptodactylus fallax* (Photo from <http://zims.isis.org>)

## MATERIALS

- Marantz® Portable Solid State Recorder, model PMD660
- Shure Beta Green BG 4.0 microphone
- 15 ft microphone cable
- Sennheiser HD 201 headphones

- Raven Pro 1.3 software
- 2 Head lamps

## METHODS

Recordings of *E. martinicensis*, *E. amplinympha* and *L. fallax* were taken using the Marantz® Recorder. One person wore the headphones and directed the microphone while the other stood nearby with the device, prepared to begin recording as soon as a vocalization was heard. Each vocalization was recorded for approximately 30-45 seconds. *E. martinicensis* was recorded in a transitional secondary forest habitat at Archbold Tropical Research and Education Center (ATREC) on the Springfield Plantation, as well as in a primary forest region near Middleham Falls. *E. amplinympha* was recorded in the early evening at Elfin Forest while *L. fallax* was recorded in the Soufriere Valley. We tried to obtain all recordings as close to the species as possible for the best reading. After collecting recordings we were able to analyze our vocalizations by using the Raven Pro software. Using this program, we were able to compare the intraspecific correlation of the weep vocalizations of *E. martinicensis* in a primary and secondary forest region, the intraspecific correlation between the tink vocalizations of *E. martinicensis* in secondary forest region, the interspecific correlation between *E. martinicensis* and *E. amplinympha*, as well as the interspecific correlation of *E. martinicensis* and *L. fallax*.

## RESULTS

Figures 4-7 represent vocalizations from three different species of frogs located on Dominica, Two different vocalizations are shown for *E. martinicensis*, and one is shown for *E. amplinympha* and *L. fallax*. Figures 8-13 show intraspecific correlation between vocalizations of *E. martinicensis* in primary and secondary rainforest habitats. Figures 11-13 show interspecific correlation between *E. martinicensis* and *E. amplinympha* while Figures 14-16 show interspecific correlation between *E. martinicensis* and *L. fallax*. Figures 17-19 show intraspecific correlation between tink vocalizations of *E. martinicensis*. Table 1 displays the values for all vocalization correlations.

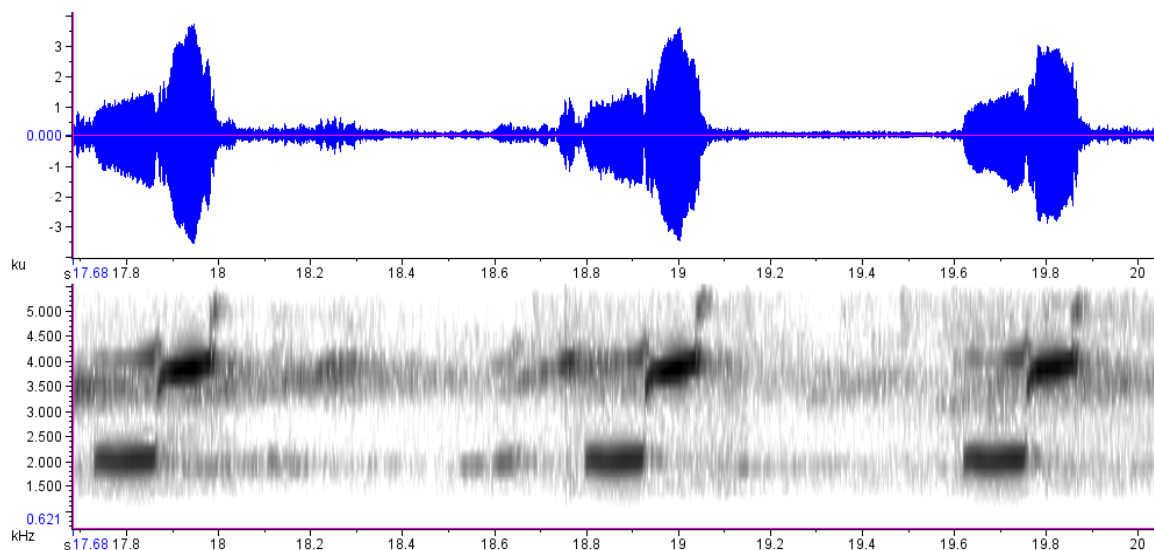


Figure 4. Weep vocalization of *E. martinicensis* at Middleham Falls.

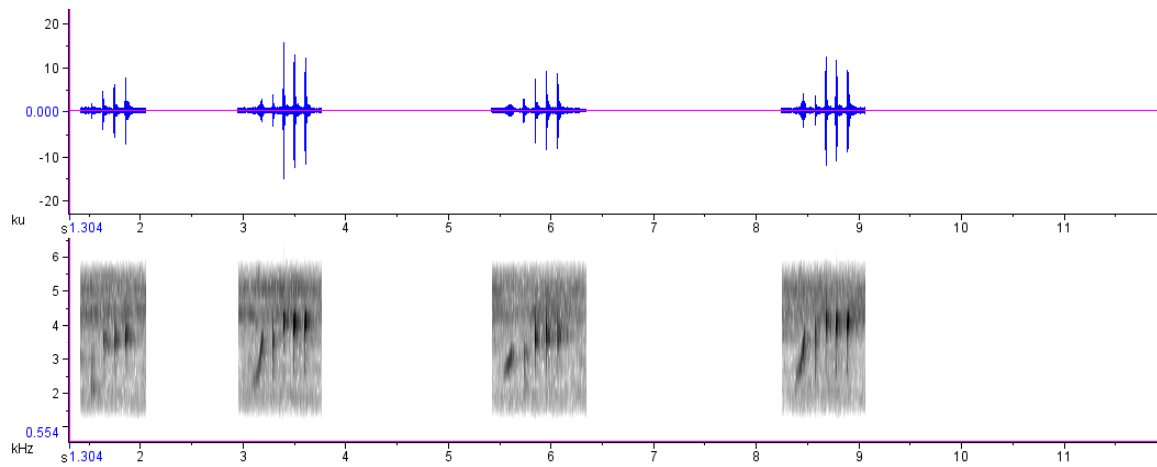


Figure 5. Tink vocalization of *E. martinicensis* in transitional secondary forest.

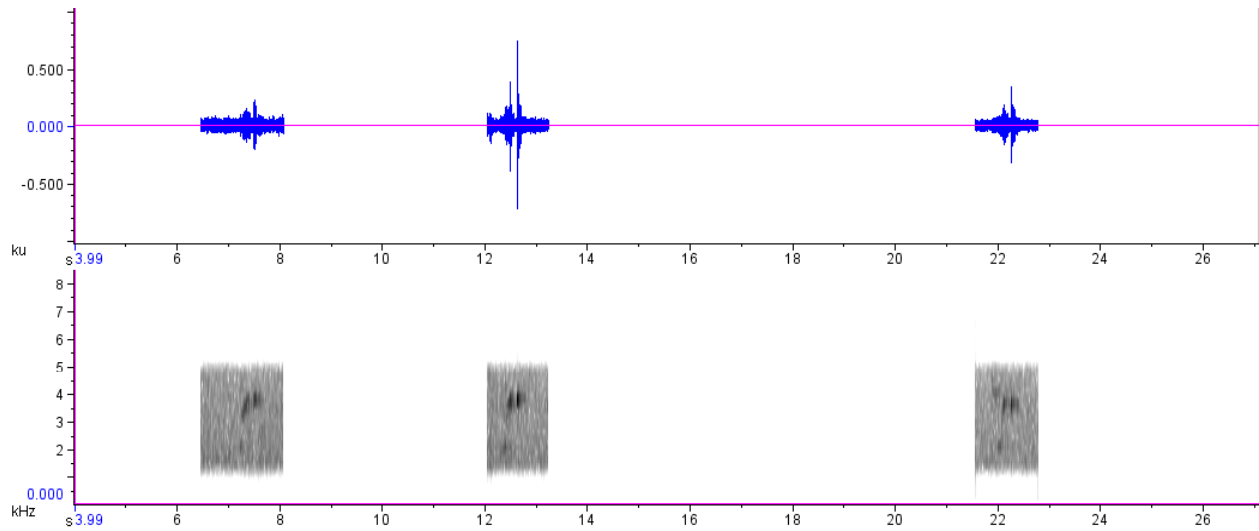


Figure 6. Vocalization of *E. amplinympha* at Elfin Forest.

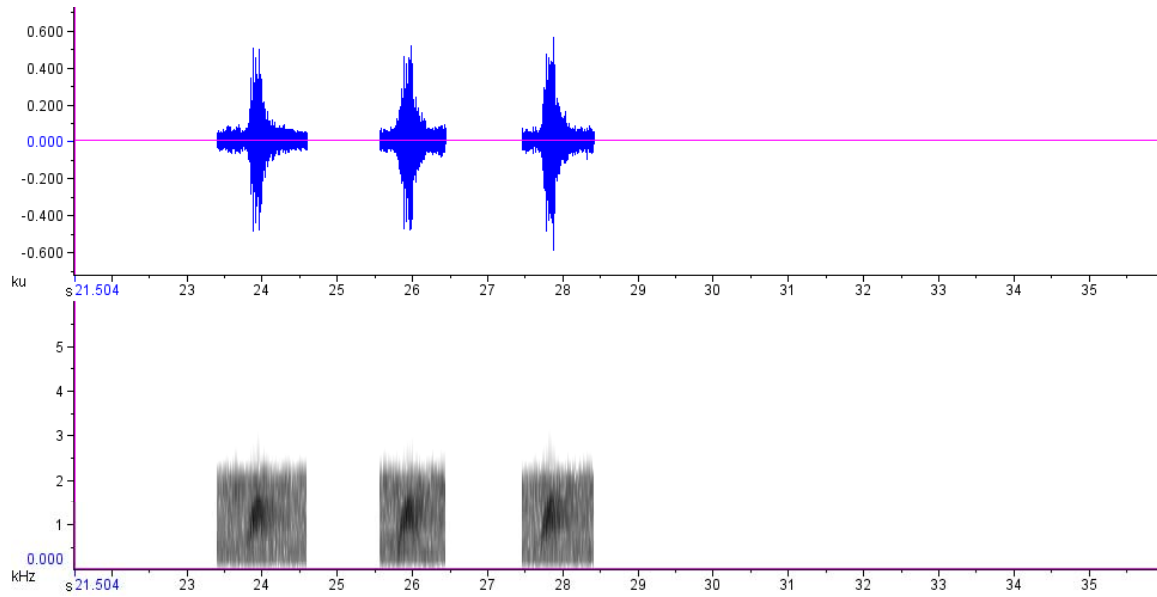


Figure 7. Vocalization of *L. fallax* at Soufriere Valley.

**Figures 8-10. Correlation between *E. martinicensis* weeps at primary & secondary rainforest.**

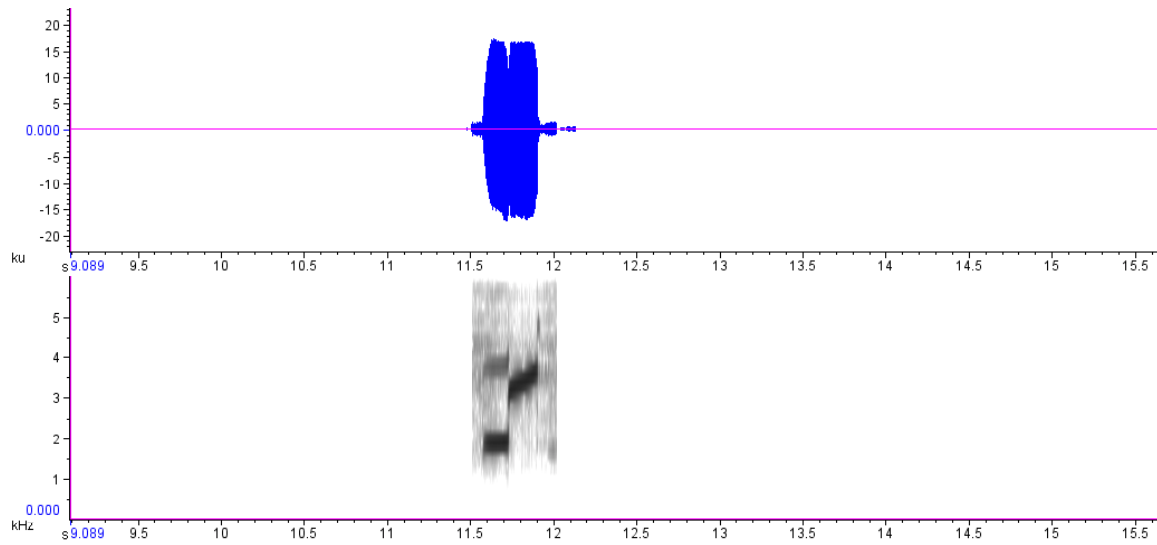


Figure 8. Weep vocalization of *E. martinicensis* at Middleham Falls, a primary rainforest habitat.

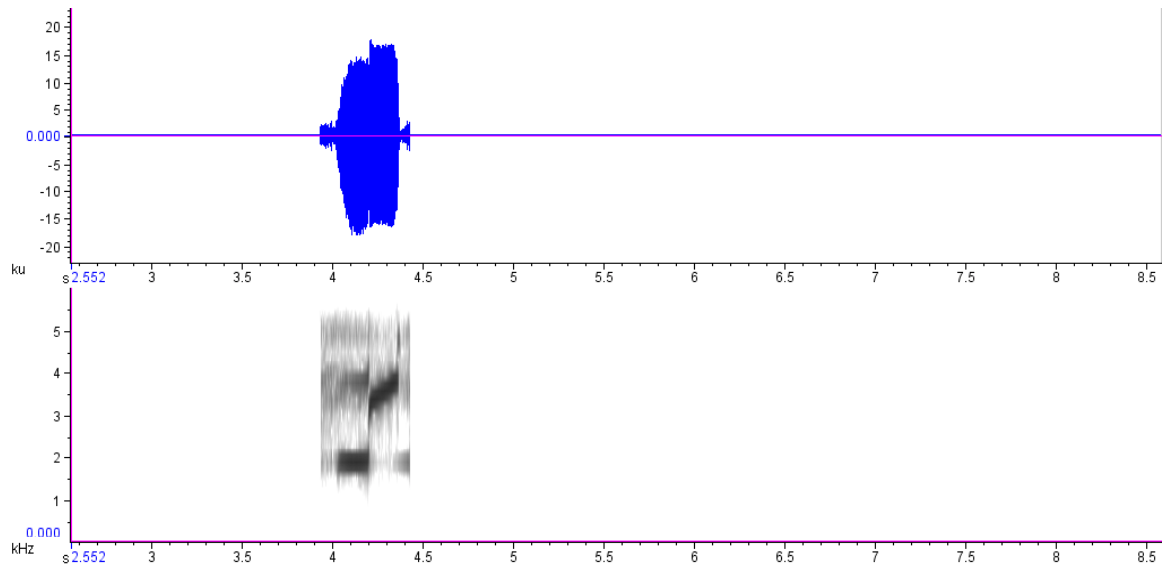


Figure 9. Weep vocalization of *E. martinicensis* in transitional secondary rainforest.

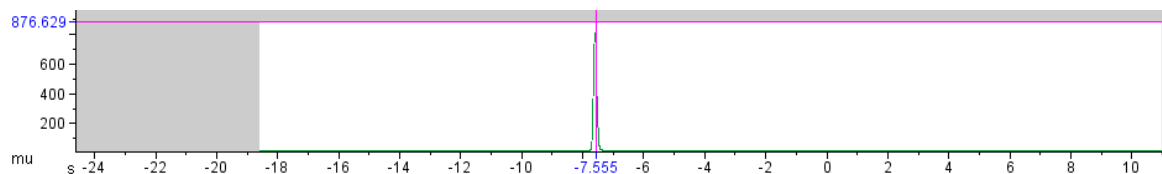


Figure 10. Intraspecific correlation between *E. martinicensis* in primary and secondary rainforest. Correlation peak is 0.877.

**Figures 11-13. Correlation between *E. martinicensis* weeps at primary & secondary rainforest.**

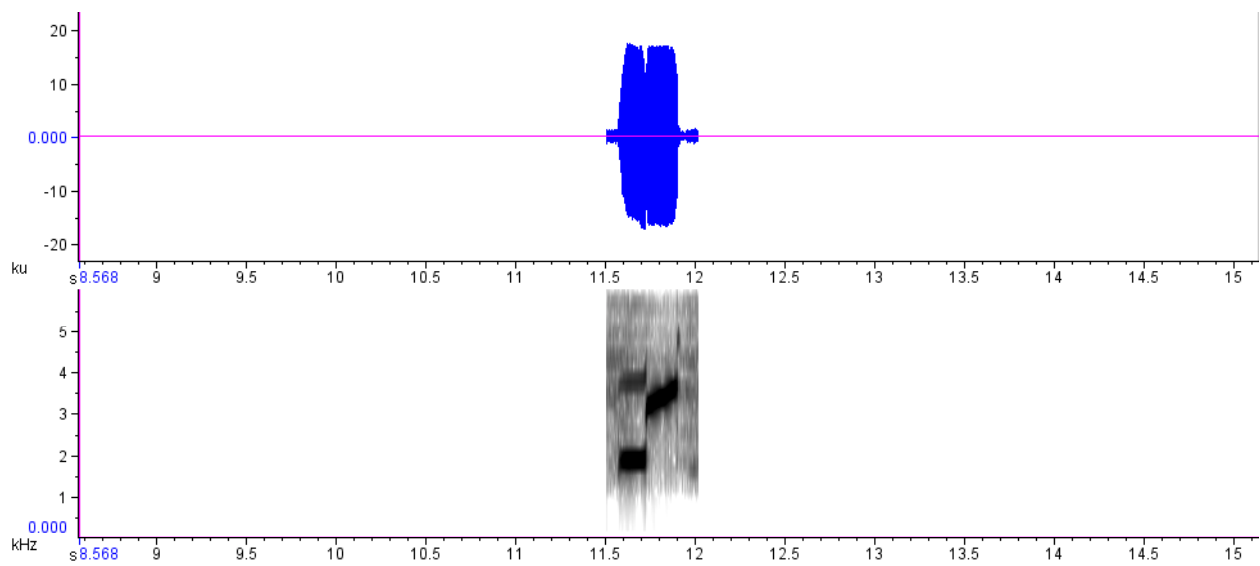


Figure 11. Weep vocalization of *E. martinicensis* at Middleham Falls, a primary rainforest habitat.

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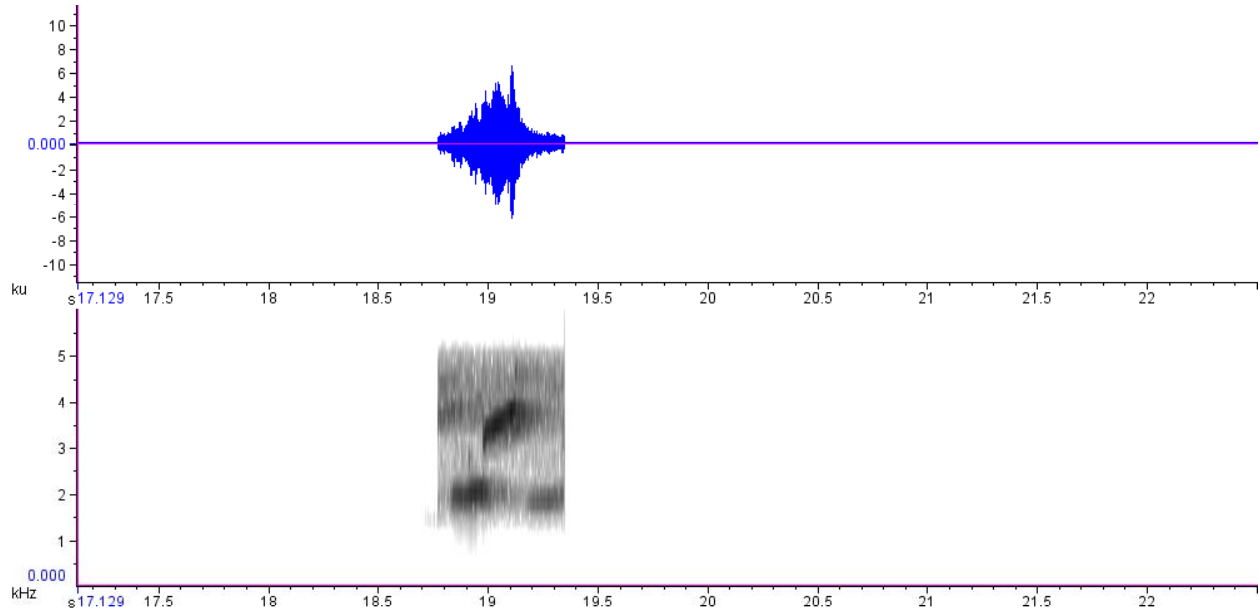


Figure 12. Weep vocalization of *E. martinicensis* in transitional secondary rainforest.

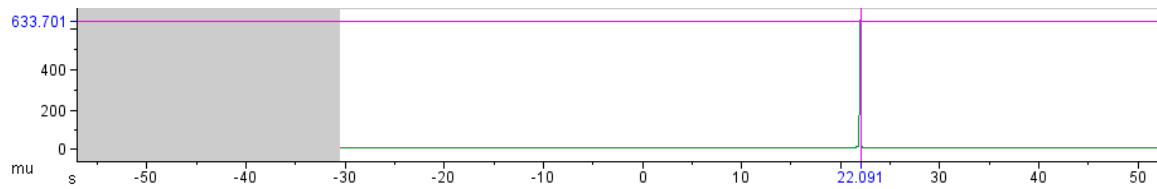


Figure 13. Intraspecific correlation between *E. martinicensis* in primary and secondary rainforest. Correlation peak is 0.634.

**Figures 14-16. Correlation between *E. martinicensis* tinks in transitional secondary rainforest.**

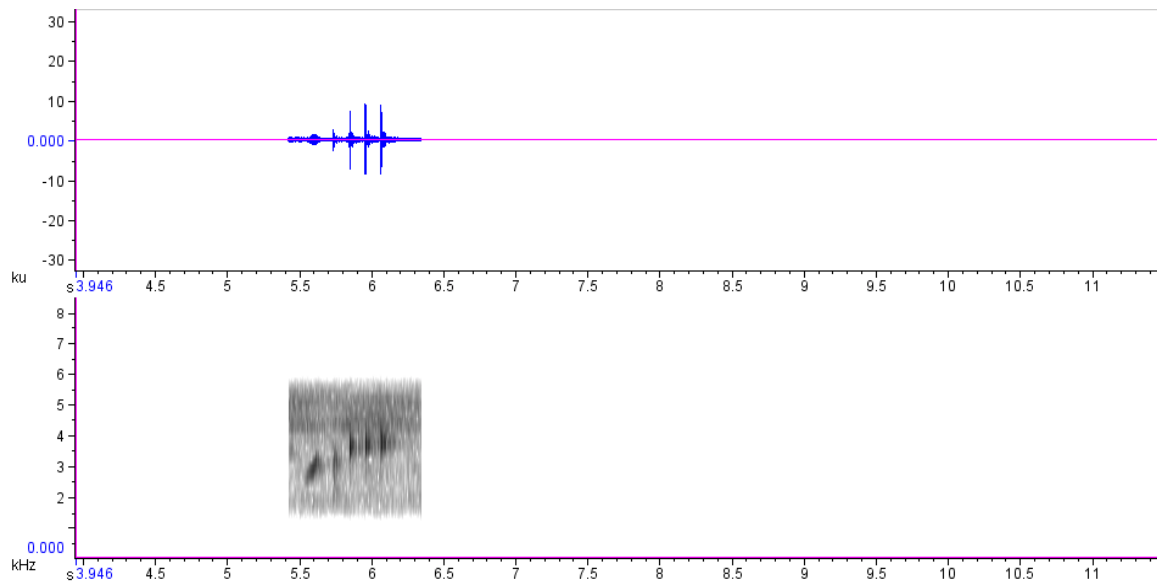




Figure 14. Tink vocalization of *E. Martinicensis* in transitional secondary rainforest.

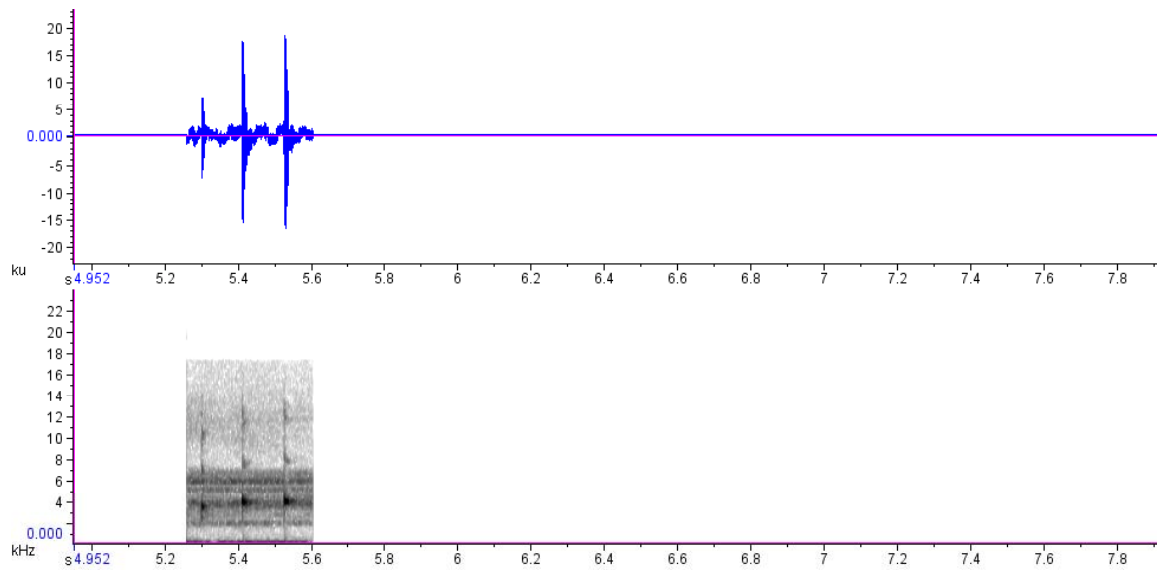


Figure 15. Tink vocalization of *E. martinicensis* in transitional secondary rainforest.

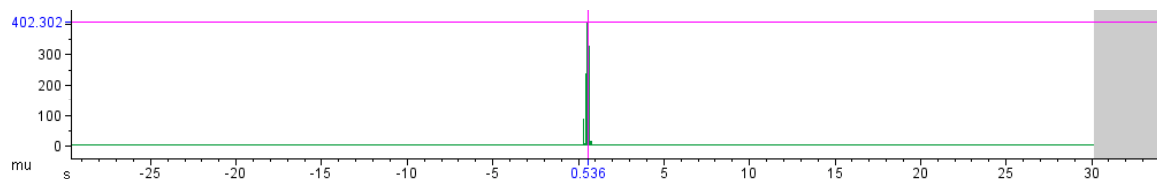


Figure 16. Intraspecific correlation between *E. martinicensis* tinks in transitional secondary rainforest. Correlation peak is 0.402.

**Figures 17-19. Correlation between *E. martinicensis* and *E. amplinympha* vocalizations.**

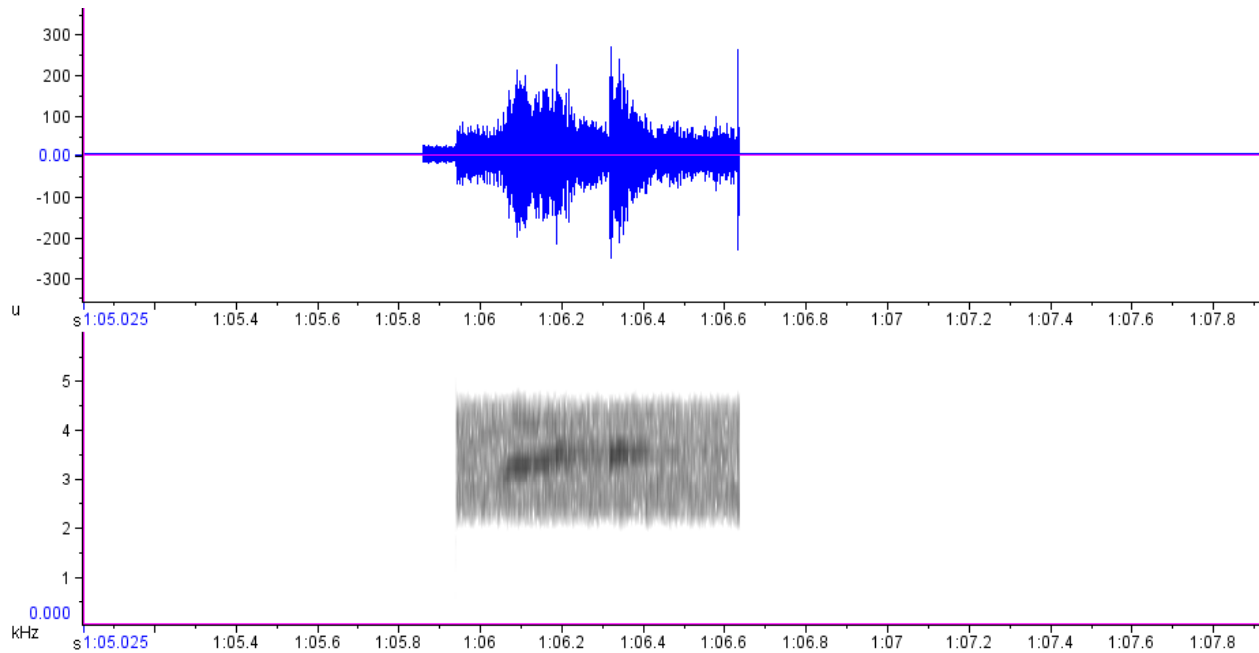


Figure 17. Vocalization of *E. Amplinympha* at Elfin Forest.

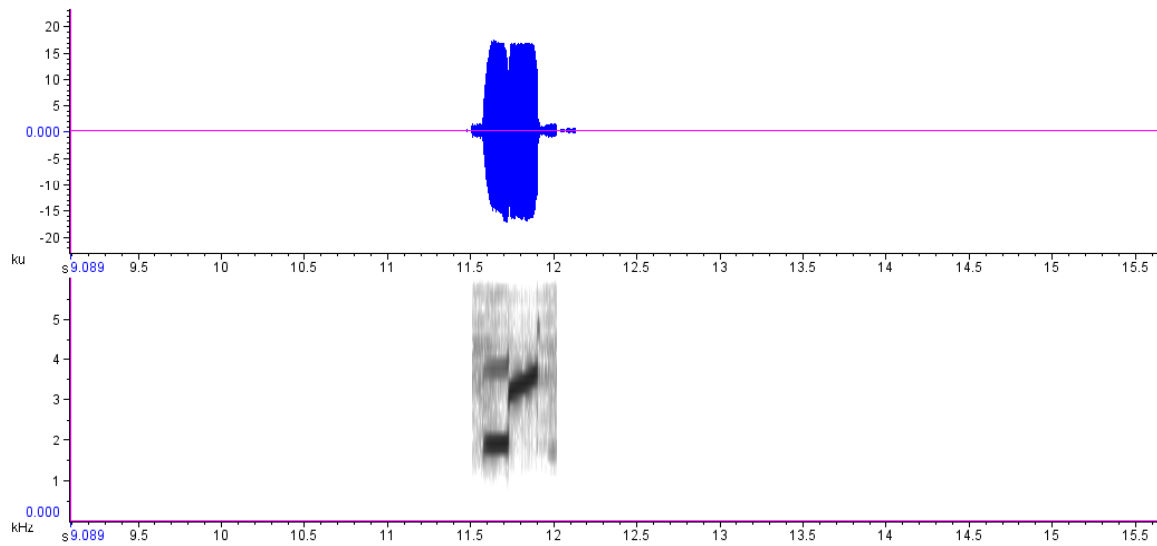


Figure 18. Weep vocalization of *E. Martinicensis* at Middleham falls.

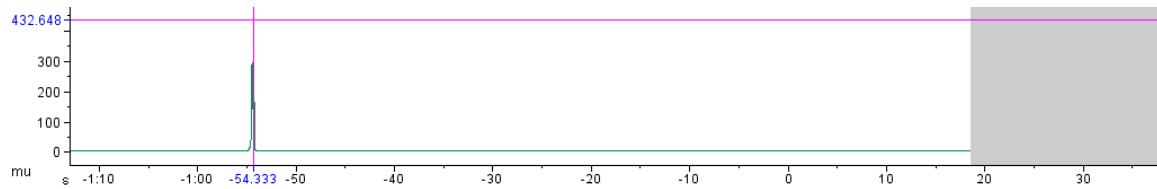


Figure 19. Interspecific correlation between *E. amplinympha* and *E. martinicensis*. Correlation peak is 0.433.

**Figures 20-22. Correlation between *E. martinicensis* and *L. fallax* vocalizations.**

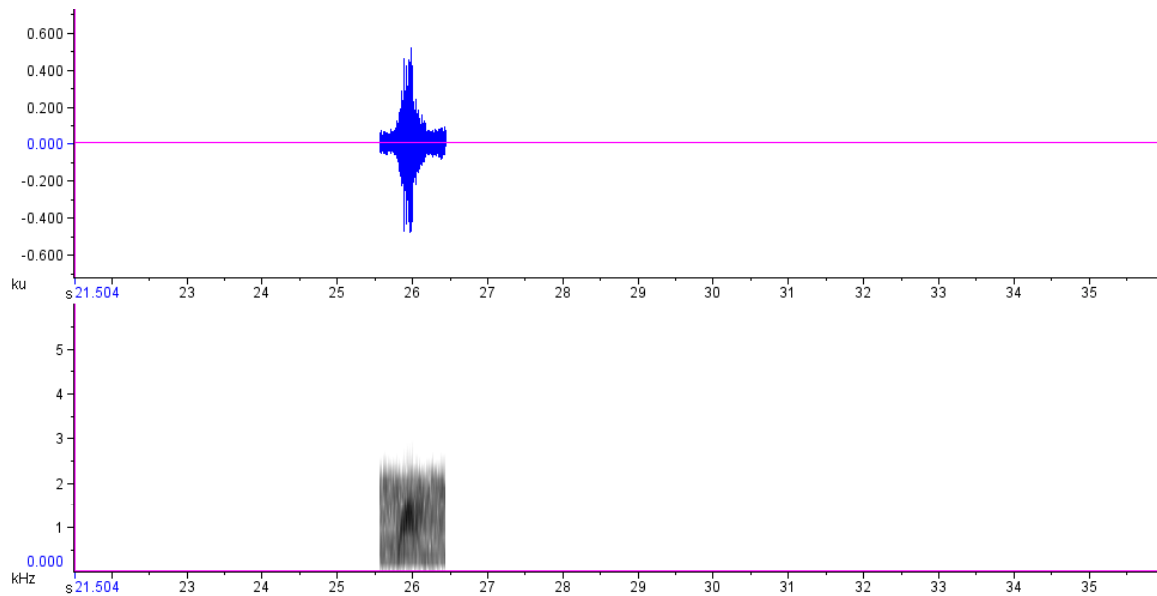


Figure 20. Vocalization of *L. fallax* at Soufriere Valley.

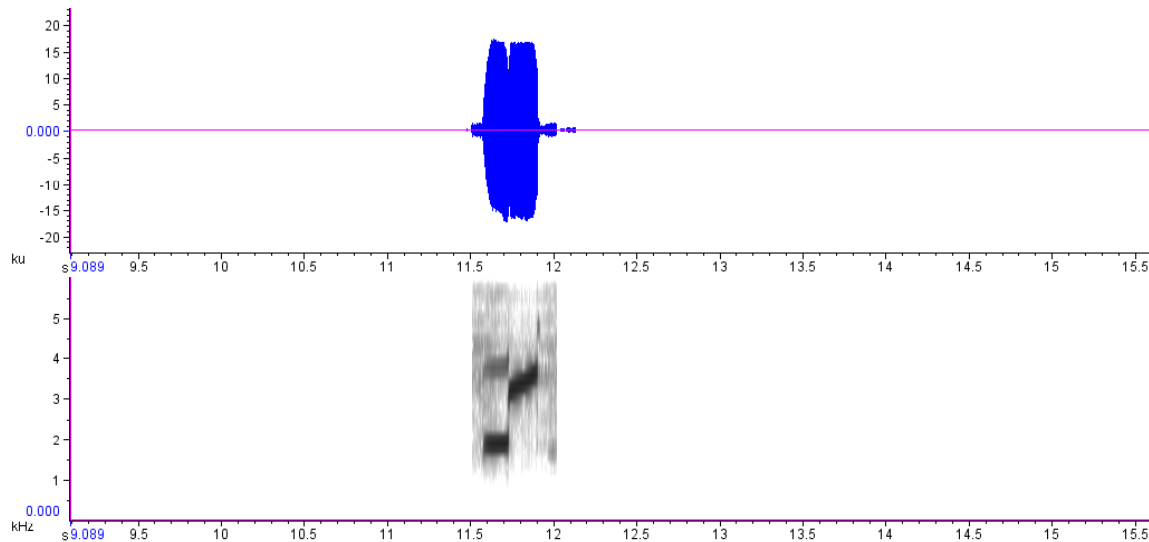


Figure 21. Vocalization of *E. Martinicensis* at Middleham Falls.

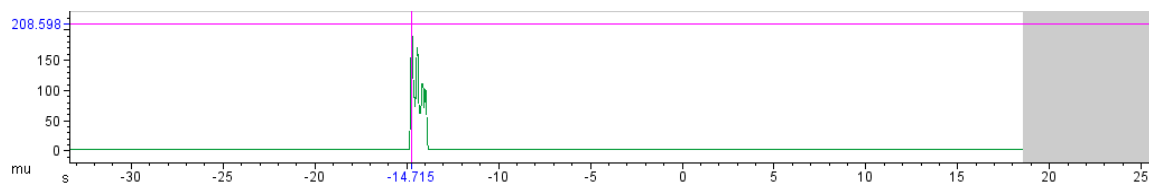


Figure 22. Interspecific correlation between *L. fallax* and *E. martinicensis*. Correlation peak is 0.209.

**Table 1. Intraspecific and interspecific correlation values.**

Species	Correlation Coefficient
<i>E. martinicensis</i> weep: Primary and Secondary Rainforest	0.877
<i>E. martinicensis</i> weep: Primary and Secondary Rainforest	0.634
<i>E. martinicensis</i> weep average	0.756
<i>E. martinicensis</i> tink: Secondary Rainforest	0.402
<i>E. martinicensis</i> and <i>E. amplinympha</i>	0.433
<i>E. martinicensis</i> and <i>L. fallax</i>	0.209

## DISCUSSION

We found the intraspecific correlation coefficient for *E. martinicensis* weep vocalizations in different habitats for four different weeps. For the first comparison the correlation coefficient was 0.877, and for the second it was 0.634. We found the simple average between these two values to be 0.756. When we compared the tink vocalizations within this species in a secondary rainforest habitat, the correlation coefficient was 0.402. The correlation coefficient between the weep of *E. martinicensis* and *E. amplinympha* was 0.433, while the correlation coefficient between the weep of *E. martinicensis* and the primary call of *L. fallax* was the lowest at 0.209.

The frequency of the *E. martinicensis* weep occurs across the widest frequency range, though the main portion of this call is similar in frequency to that of *E. amplinympha*. The call of *L. fallax*,

however, occurs at a significantly lower frequency. *E. amplinympha* and *L. fallax* occur across a more narrow frequency range.

Despite our efforts in urban areas where *E. johnstonei* had been previously reported, we were unable to locate this species. The only species we heard in these areas was *E. martinicensis*.

## CONCLUSION

The average intraspecific correlation coefficient we calculated for *E. martinicensis* in a primary and secondary rainforest habitat was the highest of the four in Table 1. This result is not surprising, since two of the other values were interspecific correlations. However, the two correlation values we averaged were notably different and the average was far from 1.0. The calls we used to calculate these values showed enough variation to suggest that the weep call of *E. martinicensis* does involve a degree of variation. The different habitats in which we obtained the recordings may attribute to the variation among the calls, but this cannot be proven with this type of data. Though the reason behind this variation requires extensive research, we find it important to consider that there are other significant variations among *E. martinicensis*. For example, they display a wide range of physical characteristics, and this may be associated with differences in vocalization patterns.

The low correlation coefficient between the tink calls of *E. martinicensis* in a secondary rainforest habitat was surprising. One possible explanation for this result may be the purpose of this type of call, which is presumably to indicate locality to other males. Perhaps different patterns and frequencies are used to indicate different locations or degrees of territoriality.

*E. martinicensis* and *E. amplinympha* had a lower correlation coefficient than the intraspecific comparison of *E. martinicensis*. Since they are of the same genus but different species, this result was as expected. The occurrence of *E. amplinympha* at higher elevations may be related to the difference in vocalization patterns and frequency. At higher elevations there are different types of vegetation and abiotic conditions.

The calls of *E. martinicensis* and *L. fallax* resulted in the lowest correlation coefficient of all those we compared. We also observed that *L. fallax* vocalizes at a lower frequency than the two species from the genus *Eleutherodactylus*. This suggests that frogs from another genus tend to use different frequencies and patterns of vocalization. *L. fallax* is also significantly larger which likely results in a lower frequency call.

If it is still persisting on Dominica, *E. johnstonei* appears to have decreased in abundance or to have moved to new niches. Based on our inability to locate this introduced species, we conclude that it is not an immediate threat to *E. martinicensis* and is no longer an invasive species.

## ACKNOWLEDGEMENTS

We would like to thank Ashley Brooks and Diana Warrendorf for recording *L. fallax* during their participation with the chytrid fungus research on Dominica. We would also like to thank the

course professors, Dr. Tom Lacher and Dr. Jim Woolley, for all of their guidance and assistance with this project.

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