

Dr. Daniela Medina-Martínez
Editor-in-Chief
Philosophical Transactions of Biology

June 28, 2024

Dear Daniela,

We are pleased to submit the attached research article entitled “Environmental drivers of calling activity in the tropical endangered species the lemur leaf frog” for consideration for the special issue Bioacoustics for Tropical Ecology and Conservation in Philosophical Transactions of Biology. In this manuscript, we present an innovative automated detection method to identify the calls of *Agalychnis lemur*, a critically endangered frog from the Neotropics. Then, by leveraging these passive acoustic monitoring data and an explicit causal model, we investigate environmental effects on the calling activity of this species.

In our paper, we demonstrate how a species-specific acoustic automatic detector can be used to adequately identify the low-complexity calls of *A. lemur*, despite the cacophonous soundscape of a tropical rainforest. We achieved an automatic detection routine capable of predicting the calls of *A. lemur* with high precision in sound files with significant background noise. Additionally, we show that a post-hoc machine learning approach can enhance the predictive power of this routine. This protocol aims to establish a foundation for future studies that seek to understand the acoustic phenology of tropical frogs using automated data processing and highly accurate detection methods.

Our findings also reveal how bioacoustic data can be applied to answer ecological questions, such as the impact of climatic fluctuations on the calling activity of an endangered species. Using an explicit causal model, represented by directed acyclical graphs, we explored the effects of environmental variables: temperature, rain, relative humidity, and night illumination, on the calling activity of *A. lemur*. Importantly, our model captures the causal relationships between the environmental effects, thus allowing unbiased estimation of these effects on frog calling activity. Our analyses indicate that high temperature and high relative humidity are the main drivers of calling activity, while moon illumination decreases calling rate, and rainfall *per se* has little effect on acoustic behavior.

We strongly believe that these novel findings highlight the relevance of automated acoustic detection for monitoring populations of *A. lemur* and other endangered tropical species. Our protocol provides a baseline for phenological studies aiming for high temporal precision, thus enabling the documentation of population changes in the context of climate uncertainty. Given that our manuscript showcases the use of causal diagrams to address ecological research and employs acoustic data to support these methodologies, we hope it will be of interest to the broad scientific readership of Philosophical Transactions of Biology.

Our manuscript contains original data and analysis and has not been published or submitted for publication elsewhere. All three authors approved the manuscript prior to this submission. Please contact us if you have any further questions.

Sincerely yours,

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