



A soundscape approach for the acoustic monitoring of the Critically Endangered Cuban frog *Eleutherodactylus bartonsmithi* Schwartz

population biology # conservation # endemic species

Context

The Cuban archipelago hosts more than 70 species of frogs and toads; more than 94% of them are endemic. Furthermore, Cuba has almost a third of the amphibians of the Antilles. Amphibians represent the second group with most threatened species in the Island with 80% of them being threatened. This project focuses on a Critically Endangered Cuban frog, *Eleutherodactylus bartonsmithi* (Schwartz 1960), which has an extremely restricted distribution range, limited to the surroundings of the Canyon of Yumurí river, from easternmost Cuba. Its population size, reproductive biology, or structure by sex and age are unknown.

Although this species occurs within protected areas (Protected Landscape Maisí-Yumurí and the Outstanding Natural Element Cañón del Yumurí), habitat modification has been considered the principal threat to its survival. In October 2016, the area was severely affected by Hurricane Matthew. Moreover, the subsequent rebuilding actions caused a great land movement and 4.5 km road was placed within the forest to connect Baracoa municipality with the town of Sabana, Maisí municipality in the Yumurí Canyon. The effects of these anthropogenic activities on the species populations remain yet unknown.

This recent human intervention and the hurricane impact combined with the scarce information about distribution and biology, demand a rapid assessment of the conservation status of this species. Then, the need of a non-invasive method, which allows to characterize the habitat and the population dynamics at the same time, arises. The analysis of the soundscape presents a solution that will allow us to answer several questions: Where are the population nuclei? Which areas are the most affected by human and natural modifications? How has the soundscape composition in the Maisí-Yumurí forest been affected by recent human intervention? How do these elements correlate?

Objectives

The main objective of this project is to evaluate the impacts of habitat modification on the behavior, distribution, and population abundance of a Cuban endangered frog (*E. bartonsmithi*) by analyzing the soundscape configuration.

The specific objectives are as follows:

- To delimitate the population distribution, estimate relative abundance, and establish the seasonal and daily activity peaks of *E. bartonsmithi* using bioacoustics tools.



E. bartonsmithi © S. del Castillo

DATES

2022

COUNTRY

Cuba

STUDENT

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EDUCATION LEVEL

Master



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- To compare the state of conservation of patches with different levels of anthropogenic disturbance of The Maisí-Yumurí forest using acoustic biodiversity indexes.
- To analyze if there is a correlation between the soundscape configuration and the population distribution and abundance of *E. bartonsmithi*.

Methods

Recording Methodology

We will perform an initial field study to delimitate the areas where the recordings will be obtained. We will establish six circular patches (with a 300m radius) with different levels of anthropogenic influence: away from the road, near the community, and near the newly constructed road. Six acoustics recorders will be deployed at the center of each patch. A program will be setup for a long-term recording (24 hours for five consecutive days). This methodology will be used for a more accurate assessment of soundscape values, while nighttime recordings will be used for specific studies on *E. bartonsmithi* calls.

Acoustic data processing

From each recording site we will randomly select 30 seconds recording samples occurring between dawn and dusk (6pm-6am), when it is most likely for the species call to occur. These recordings will be analyzed to determine the presence of the species, the call rate, the total duration of the calling, the loudness (mean dB) and SNR (Signal to Noise Ratio). These features will be considered to calculate population-specific measurements like vocalization activity, estimated density, and estimated abundance. For better precision we will also train a Random Forest ML algorithm to automatically recognize frog calls in our recordings.

Acoustic Spectral indexes

Long term recordings make it impossible to extract information of every second of the recordings. Spectral acoustic indexes arise as a solution to summarize the information of such recordings. In this project, we will focus on the Acoustic complexity index (ACI), the Event spectrum index (EVN), and the Temporal entropy spectrum index (ENT). These indexes will be calculated and compared among the six different recoding areas and compared seasonally. LDFC (Long Duration False Color) spectrograms will also be generated for each area and season. We will also calculate the Acoustic Entropy Index and Acoustic Dissimilarity Index to characterize the areas biodiversity.



Expected results

- Identification of population nuclei of *E. bartonsmithi* and relative abundance within a section of the Maisí-Yumurí forest
- Characterization of the acoustic behaviour of *E. bartonsmithi* including seasonal and temporal distribution of call activities, activity peaks, rapid variation in frequency and sound intensities (automated detection of frog chorus activity to species level in environmental recordings)
- Delimitation of the most vulnerable sites within the Maisí-Yumurí coastal forest as well as the best preserved based on the soundscape configuration
- Providing of feedbacks to establish priorities in the Protected Landscape Maisí-Yumurí and the Outstanding Natural Element Cañón de Yumurí management plan
- Gathering of acoustic data of a previously unrecorded area; the recordings can not only be used by us, but further used by other researchers or ourselves to target another species or features of the area
- Validation of a new method in the Cuban conservation and species management field, which is completely reproducible across other Cuban forests for further soundscape assessment



About the research team

Mariam obtained her bachelor's degree in Biology at the University of Havana (Cuba). She is currently finishing her second year at the Université de Bourgogne Franche-Comté (Dijon, France) enrolled in the Master program Behavioral Ecology and Wildlife Management (BEWM), thanks to the financial support of Caribaea Initiative. This project, also funded by the association, is part of the final exercise of the master's degree.

Mariam is also currently working as a researcher and professor in training, specifically at the Museum of Natural History: "Felipe Poey". She is supervised by Dr. Roberto Alonso Bosch, senior researcher and Director of the Museum of Natural History "Felipe Poey", and also counts on the assistance of MSc Sergio Luis del Castillo Dominguez, researcher at the Institute of Ecology and Systematics (Cuba).

