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Final Project Evaluation Report

We ask all grant recipients to complete a project evaluation that helps us to gauge the success of your project. This must be sent in **MS Word and not PDF format**. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Complete the form in English and be as concise as you can. Note that the information may be edited before posting on our website.

Please email this report to jane@rufford.org.

Your Details	
Full Name	Silvio Macias Herrera
Project Title	Bats of two "hot caves" in Cuba. Research and individual capacity building toward its conservation.
Application ID	16537-1
Grant Amount	£4950
Email Address	smacias1@jhu.edu
Date of this Report	October 8th, 2017

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Study of bats activity in the two hot caves will be done by using acoustic methods		X		
Provide data on relative population size of bat inhabiting both caves together with an overview of population dynamics both in the temporal and the spatial domain along a year.		X		
Capacitating personnel working and living nearby the caves.		X		

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.

We faced two main difficulties during the project. The first one was related to the use of acoustic methods for the accurate identification of bat species inhabiting both caves. The acoustic repertoire of bats echolocation is very variable, species-specific and context dependant. We were able to identify, using only acoustic methods, eight out of 14 species inhabiting both caves. The rest of the species were classified as unidentifiable or included in a larger group of species that shared similar acoustic characteristics in their echolocation behaviour. The second difficulty was related to the capacitation of the personal living around one of the caves. This cave, "El Mudo" is located inside a Buffalo milk producing farm and the personal working in this farm is constantly replaced.

3. Briefly describe the three most important outcomes of your project.

a) Bat populations in both caves were studied using Automatic Recording Units (ARU). ARUs were placed in different places of the caves and in each of the different cave entrances. Each unit was programmed to record sounds for 1 minute every 10 minutes during the day and 1 minute every 5 minutes during the night when bat activity was increased. Each week data collected by ARUs was storage and taken to the lab for further analysis. Each species of bat was identified by the features of their echolocation calls and the rate of appearance of these calls provided an idea of abundance of each species. The species of bats inhabiting each cave were determined also through photographical methods. A camera set with automatic lights was positioned in the entrance of the caves during the evening and nocturnal exodus. These data served for species inventory, data on species dynamics and cave bat guides.

b) Capacitating activities for local personnel and educative talk's for communities on cave bats. Six visits (September 2015, November 2015, January 2016, March 2016, May 2016 and July 2016). Capacitating of local personnel helped to continue the monitoring of bat populations and continuing the record of data on its biology to improve management. Communities nearby the caves learned on bats fauna and how and why they need to be protected.

c) Elaboration and delivery of didactical pamphlets and a guide of bats to local personnel. This accompanied the capacitating and educational activities.

4. Briefly describe the involvement of local communities and how they have benefitted from the project.

We organised a group within the communities, to protect bats inhabiting hot caves. We developed a workshop in the primary and secondary school with children of this community, between 5 and 14 years old. We gave several talks about general characteristics of bats inhabiting in the hot caves and their importance, and other regarding new born bats and how to avoid cave disruption during bat reproductive period. Children were able to see bats alive, in which they could recognise differences among species in colour, size and wing membrane features. They were able also to draw some of these bats. We delivered a couple of educative materials regarding Cuban bats to the principal of this primary school to be hung in classrooms and halls from this school. A few workshops were organised with the personnel working in the farms around the caves. They learned how to use the ARU and check them regularly.

5. Are there any plans to continue this work?

There are no plans to continue this work.

6. How do you plan to share the results of your work with others?

The results obtained from this project are part of a couple of publications submitted to peer-reviewed journals and authored by students of the Faculty of Biology, University of Havana. Also, children from schools around the caves and personnel working in nearby farms are sharing information in pamphlets and guides with other members of the community.

7. Timescale: Over what period was the grant used? How does this compare to the anticipated or actual length of the project?

The grant was used over a year. This was in agreement with the anticipated length of the project.

8. Budget: Provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Transportation to the caves and local communities.	500	500		
Food supplies	500	500		
Fuel	600			
Head Lamps	200			
Batteries	100			
Laptop	700			
Printer	350			
Printer toners	300			
Paper	150			
Professional Digital Camera	700			
Automatic flash	800			

9. Looking ahead, what do you feel are the important next steps?

Next steps should be to create a conservation management plan for this areas and include new caves. It should be important to involve local government for the conservation and study of these caves, which constitute refuge for 75% of bat species in the island.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

We used the Rufford Foundation logo in every materials and presentations.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Silvio Macias. Head of the project, involved in field trips and educational activities.
Emanuel C. Mora, involved in field trips, photographer recruiting undergraduate students.

Christian Moreno, field trips, specialist on bat breeding biology and development.
Lida Sanchez, field trips and educational activities.

Yohami Fernandez, field trips, photographer.

A significant number of students of the Faculty of Biology, University of Havana involved in field trips and educational activities.

12. Any other comments?

Workshop developed in the primary school from El Mudo community, Mayabeque province, Cuba.

Students setting the ARUs inside the caves.


Bat evening exodus.

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Can echolocation calls of Cuban mormopid bats visualized through a heterodyne system?

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ABSTRACT.— In this study, we evaluate the potential of the heterodyne system for the acoustic identification of bat species from Mormoopidae in Cuba. The heterodyne transformation of the echolocation calls of the three mormoopid species of *Pteronotus* (*P. macleayii*, *P. quadridens* and *P. parnellii*) was initially analyzed by setting the frequency of the heterodyne detector (f_{tuned}) 5 kHz above and below the constant frequency value of the second harmonic, respectively. We then studied the feasibility for the identification of several *Pteronotus* species with single f_{tuned} values. The heterodyne transformation of calls from the mormoopid *Mormoops blainvillii* and four Cuban phyllostomid bats was studied by selecting frequency values contained in the calls of each of the species under study. We showed that, by selecting the appropriate f_{tuned}, the *Pteronotus* species could be accurately identified based on the spectral signatures of their heterodyned calls. Frequency modulated (FM) bats presented very similar heterodyne signatures and therefore could not be identified to species level. The study points to heterodyne detectors as appropriate to conduct acoustic surveys of mormoopids and other constant frequency (CF) and quasi CF bat species.

KEYWORDS.— acoustic identification, heterodyne, Mormoopid, *Pteronotus*, bat detectors.

INTRODUCTION

Bats (Order Chiroptera) usually comprise more than 50% of the mammalian species in tropical habitats, and hence constitute a considerable and important component of the biodiversity (Findley 1993; Voss and Emmons 1996). Tropical bats perform important ecological functions in ecosystems such as pollination, seed dispersal, and predation (Jones et al. 2009; Findley 1993; Kalko 1998). Monitoring of bat's populations is vital for the conservation of this group (Fenton 1997). Study methods such as mist nets and harp traps, are often used to perform inventories and surveys (e.g., Fenton et al. 1992; Findley 1993; Kalko 1998; Simmons and Voss 1998). There are bats however, with high flight and/or maneuverability that are difficult to catch and therefore often go undetected (Kalko 2004). Bat monitoring using acoustic detection of their echolocation calls is a non-invasive technique and has been shown to be a powerful supplement to standard capture methods. It is proved that it allows the identification of many species that are generally underrepresented in field inventories (O'Farrell and Miller 1999; O'Farrell et al. 1999).

Acoustic monitoring is based on the fact that spectral and temporal features of echolocation calls are usually species-specific (Griffin 1958; Ahlén 1981; Fenton and Bell 1981; Fullard et al. 1991; Rydell et al. 2002; Ibañez et al. 1999; Macías et al. 2006a). However, many bat species have a broad call repertoire, which makes acoustic identification challenging. In the neotropics for example, bats from the family Molossidae show a high plasticity in their search calls, which involves frequency shifts (Gillam and McCracken 2007; Gillam et al. 2009; Mora et al. 2004), and alternation of call designs within call sequences (MacSwiney et al. 2006; Mora et al. 2011b). On the other hand, bats from families like Phyllostomidae and Mormoopidae are good examples of species with limited echolocation repertoires (Kalko 2004; Macías et al. 2006a; Mancina et al. 2012). Species from Phyllostomidae broadcast similar echolocation call patterns with short, multiharmonic, and broadband calls (Griffin 1958; Howell 1974; Barclay et al. 1981; Belwood 1988; Fenton 1995; Kalko and Condon 1998; Schnitzler and Kalko 1998, 2001; Macías et al. 2005; Macías et al. 2006b). These common call attributes restrict within-group species identification using

Paper published in the Caribbean Journal of Science with data collected from field trips.