The Rufford Small Grants Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other 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. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Lida Sánchez Sánchez
Project title	Acoustic monitoring as a non-harmful tool to monitor *Natalus primus*, a critically endangered bat species from Cuba
RSG reference	16094-1
Reporting period	January-October 2015
Amount of grant	4 890£
Your email address	liditasanchez89@gmail.com
Date of this report	January, 15th, 2016

1. Please 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
To describe the activity pattern of the species		X		Please refer to comment 1 below
To describe the distribution of the species inside the cave		X		Please refer to comment 2 below
To describe the two dimensional use of the cave entrance by this species	X			Please refer to comment 3 below

Comment 1:

Bat activity pattern was assessed through acoustic identification of echolocation calls. Acoustic recorders were set in the entrances of the cave (see pictures and detailed explanations on previous reports) and scheduled to record all night. The cave where our target species inhabits constitutes one of the most specious caves in Cuba (Tejedor et al., 2005), with 12 species all year round. During the night exodus, bats come out at the same time, causing a frequency overlap in the recorded acoustic files (Fig. 1). This makes the species identification very complicated, especially because 9 species in this cave share a similar spectro-temporal pattern (descendant frequency modulation). Spectrograms templates from all the bat species roosting at La Barca where made, including modifications of the call sequences (echolocation calls during the search, approach and buzz phase). Intra-specific variations were also taken into account, using echolocation calls from more than 10 individuals for most of the species to build these templates. This will allow the program to have more certainty in the identification. In the case of our target species, we had to record first their vocalizations to obtain the templates. We made a total of 328 spectrogram templates for all the species in cave La Barca.

It took us time to make spectrograms templates to work properly, avoiding false positives (labelling incorrectly the species) during the automated identification. Most of the detections were visually inspected afterwards to check that no false positive occurred.

Taking into account the amount of data collected during each field trip (Table 1) we were not able to process all the data by the end of the project and therefore we cannot give conclusive results regarding this objective.

Comment 2:

Knowledge about roost requirements are essential for species survival. We wanted to know among the galleries within cave La Barca, which of them is preferred by

Natalus primus. For this reason we conducted acoustic monitoring inside the cave, locating this time the acoustic recorders along its galleries, at low heights and very close to the walls (this is due to the flight pattern of our target species).
Visual observations were made as well, using red lights to avoid disturbing of bat species. We also observed individuals from *Natalus primus* using the heat trap (same as reported by Tejedor *et al.*, 2004) and also contiguous galleries to this one. Acoustic records will offer more reliable results due to non-perturbation from researcher's presence and a 24 hours period of continuous recording. We would need more time to process these data.

Comment 3:
One of the threats attributed to this species in the description of its critically endangered condition by the IUCN Red List, is human disturbance at the roost. Fortunately, cave La Barca is well preserved and no signals of human disruption are evident (Fig. 2). In our feedback with forest rangers in the area, they made the comment that almost no one goes inside the cave, especially to the heat trap in which most of the bat species roost. Guano swamps probably had offer a good mean to isolate bats from unwanted visitors. Most of the visits to the cave are restricted to the well ventilated and illuminated galleries, in which almost no bats species roost.

Taking this into account, we decide to tackle another topic which has not been explored so far and it's related to the second threat given in the IUCN Red List page (Dávalos and Mancina, 2010): habitat loss. Foraging areas for this species are unknown, and most of the information offered so far has been related to its roost (Tejedor et al., 2004). If this species faces habitat loss, more studies should have to be conducted at important sites besides the roost. This was our goal from June to the end of the project in September 2015.

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

There were no difficulties during the period in which the project was developed. One of the aims of this project was switched by another (previously explained) in order to obtain more relevant information about the species.

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

1) The description of the vocal behaviour of the species: ultrasound vocalizations from *Natalus primus* were unknown and will allow to identify this species among other Cuban frequency modulated bat species during future acoustic surveys.

2) Updated status of the species checked through the capture of some individuals: physical inspection of the individuals captured allowed to have updated measurements (forearm length, body weight) and data about its reproductive condition (information not offered through acoustic methods).

3) Through our field work we could confirm that human disturbance to the cave do not constitute a real problem for bats roosting at La Barca cave.

4) Data collected in relation to distribution of the species in the cave, activity pattern during the night exodus and areas selected to forage will offer new information about the natural history of this bat. Different locations within Guanahacabibes Peninsula were sampled (Fig.
3) trying to cover an area around the cave. All night recordings (Fig. 4) will allow to describe not only the activity pattern (measured through echolocation passes) from *Natalus primus*, but other bats species as well, so far unknown in this area for each one of these locations. Species composition could be different, or species could have specific preferences, and others might not. We obtained (not all the data analysed so far) bat activities through the acoustic species identification (Fig. 5 A) for a period of time. After data analysis is concluded, our intentions are to obtain graphs such as those published for other species (Kalcounis et al., 1999, Furmankiewicz and Kucharska, 2009) reflecting bat activity (Fig. 5 B and C). This will allow us not only to have bat activity on each night but also within periods of the year and different locations within the National Park.

5) Acoustic records were accompanying by temperature and relative humidity records within the cave, which haven't been measured for this locality since the beginning of 2000. This environmental variables could be key elements in the roost selection for this species, just as it has been found for other Natalid species (Flores and Torres, 2013). See previous reports to check for graphs on these variables.

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

Bat Conservation constituted a new line of concern for Guanahacabibes National Park. The personal staff had experience in the work with sea turtles and migratory birds. Even though when this Park counts with a unique bat species in the area, no attention had been paid to them. Forest rangers were the most involved in our work. We developed great relationships with them and their support on each filed trip was fundamental to accomplishing our goals. They helped us to explore other caves in our search for *Natalus primus* (see previous reports for details). They were very interested in our work and we let them know about our progress on each one of our field trips (Fig. 6). We conducted a workshop to teach them how to collect bat species (setting mist nets), how to make the physical identification of the species (aided with bat tabloid from our first report) and how to set the acoustic recorders.

Within Guanahacabibes National there is a small community, counting only with 6 children. We conducted two activities with them to teach them about bats (Fig. 7). They knew about birds and sea turtles, but they knew nothing about bats. It was a rewarding experience to teach them about bat's general characteristics, making comparisons with humans all the time. For further information, please see previous reports.

5. Are there any plans to continue this work?

We consider our work as the first step, as our knowledge of the species' ecology and behaviour is still very poor. Information gathered throughout this project helped to update the information about the species so far and could encourage researchers from other fields to study more details of its natural history. Many

interesting questions had been raised from our project, not only from the descriptive point of view. There are not many studies about the bat species from this family (Natalidae). For example, *Chilonatalus micropus macer* is one of the species from this family and almost no studies exist about it. Although, this species can be found in several cave ecosystems in Cuba.

Data gathered in different months of the year should be completed to have the certainty of which locations are the species' foraging areas (resampling the same locations in different seasons and extend recording locations relative to the cave). Guanahacabibes National Park counts with one of the most preserved forests in Cuba. Effects from forestry are unlikely to affected this and other bats species, but this zone is the most likely to be affected by hurricanes. No studies have been conducted relating the effect of hurricanes on bat fluctuations in this area.

With all the sound recordings gathered during the project and those previously existing from the library of Bioacoustics and Neuroethology Research Group, we were able to develop also an Echolocation Identification Key (Fig. 8). This will be very helpful to identify bat species in future acoustic surveys. This was especially developed for the forest rangers and personnel from the Guanahacabibes National Park. Our intention was that these people could identify bat species without getting too deep into the acoustic processing, just making simple frequency measurements and noticing the spectro-temporal pattern. By making this process simple, more people not familiar with bat bioacoustics would be able to use our methods as well. Besides, this identification key could be used also in other regions in Cuba as well.

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

From the point of view of supporting information for the technical staff in the National Park:
Each one of the reports made in every field trip during the course of the project (January-October, 2015) have been delivered to the personal staff in the Park (Spanish version). In this way, they could have the information as well. Our results complemented the information that they had about bats and that was not updated due to the lack of this kind of studies in this National Park. Information about bats inhabiting in Guanahacabibes National Park will be expressed in posters telling the natural values of the Park (in terms of biodiversity) and environmental publicity related with the bats inhabiting the Park and the needs to protect them.

From the point of view of scientific work:
All the data obtained in this project will be published on international scientific journals (one paper is in preparation to be submitted on ***Naturwissenschaften***). Data obtained from the project was already presented in two biodiversity conservation meetings. The *spectrogram templates* created from the echolocation calls recorded will be added to the Cuban bat echolocation calls library. We also had the opportunity to record echolocation calls from other bats within the Natalidae family, in which the studies of bioacoustics have been very limited (Murray et al., 2009).

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

The grant was used from December 2014 to October 2015. It was anticipated one month before the actual first field trip due to the need of buying some items, such as headlamps and batteries.

8. Budget: Please 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.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Headlamps	160	159.2	0.8	Additional head lamps were bought for the forest rangers that joined us during all the field trips
AA Batteries Alkaline	200	67.37	132.63	This difference was used to buy rechargeable batteries
AAA Batteries Alkaline	Not included	58.25		Some items such as the headlamps used this kind of batteries.
AA Batteries Rechargeable	Not included	36.95		
AAA Batteries Rechargeable	Not included	24.95		
D Batteries Alkaline	300	332.5		Song Meter deployment (4 batteries each)
9V Batteries Alkaline	250	15	235	This difference was used to buy more AA and AAA batteries.
Sleeping Bags	80	75	5	
Women Hiking boots	50	48	2	
Camping Tent	150	480		We bought two individual camping tents
Digital Camera	350	285.7	64.3	
Camera tripod	20	13	7	
Laptop	400	450.65		
Hard Disk	Not included	140		
Insect repellent	30	50		Additional bottles were bought fo the forest rangers working with us.
Infrared lights	300			This amount was used on fuel
Workshop activities	250	240	110	Used on environmental education activities
Environmental education activities	Not included	70		
Publishing materials	150	100	50	

Food	550	650		
Fuel	300	700		
Car rental	1000			This was used on bus tickets, fuel and contingences
Contingences	350	400		
Total	4890	4396.57	493.43	

The local exchange rate used was 1.42 CUC per 1 £ sterling

We made some adjustments taking into account that we change one of our objective for another one, so a couple of items were not bought and money was used in other items (highlighted in red on the table). Car rental was complicated sometimes due to the overlap with tourist season, we preferred instead to pay the fuel to move ourselves within the National Park. Receipts concerning most of these expenses (headlamps, fuel, food, batteries, camera and hiking boots) were kept.

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

Taking into account the results obtained in this project, we consider the next step will be to guarantee a long term monitoring of the species. Personnel and the local population within the National Park should be educated on issues related to biodiversity conservation to ensure the sustainability of the region as a whole.

Implementing acoustic methods would be an ideal tool for this, because it causes no distress to bat populations. However, for this purposes we will need to keep the Song Meters recording for long time periods. Some of these automatic units could be bought to leave in the National Park.

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

The logo from the Rufford Foundation was used in the educational materials published for the children, promotion and materials for the technical staff in the National Park in Guanahacabibes (Fig. 9) (Refer to materials published on each field trip in the website). This logo was used also in the scientific reports made in every field trip during 2015, recognizing Rufford Foundation as the main sponsor of all the activities developed. Logo was also used on presentations made in the workshops and biodiversity conservation meetings as well as t-shirts designed to promote the project (Fig. 11).

11. Any other comments?

I'm very grateful to the Rufford Foundation for allowing me to get closer to one of the most critically endangered bat species in the world. This is one in a lifetime opportunity! All of my expectations from the scientific point of view that I made during the conception of the project, were certainly met. This project also helped me out to develop a good relationship with forest rangers and to value their work. As a result of our interaction, they understand more the biology of bats and the need to preserve them. I also had the opportunity to introduce other researchers in Cuba, to the personal staff in the Park, creating long-lasting bonds

for future works and collaborations related with the ecology and conservation of the bats species inhabiting this region. The Rufford Foundation offers unique opportunities to young researchers like me, so we can carry out the field work that is so much needed to realize the conservation issues of many animal species. Thank you!

Figures and tables

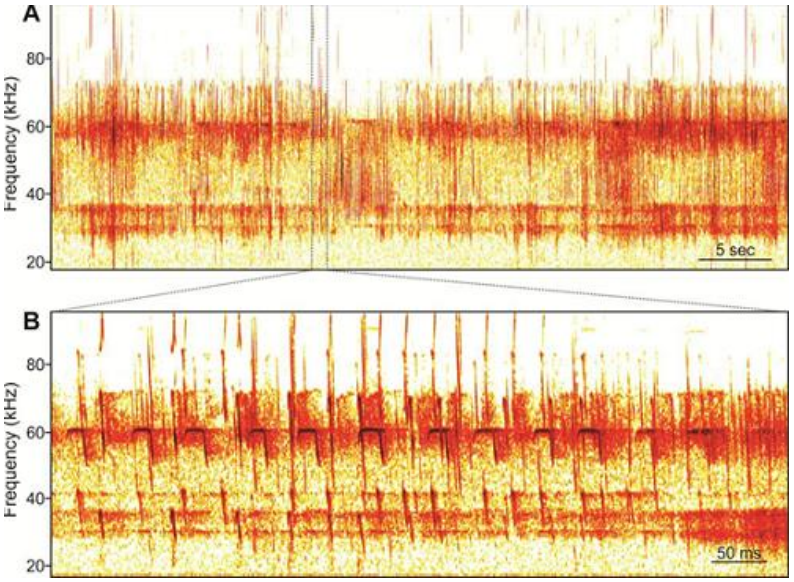

Figure 1. (**A**) Sound file recorded at one of the entrance in cave La Barca, Pinar del Rio, Cuba. (**B**) Expanded section from the sound file, showing the frequency overlap among bat species inhabiting cave La Barca.

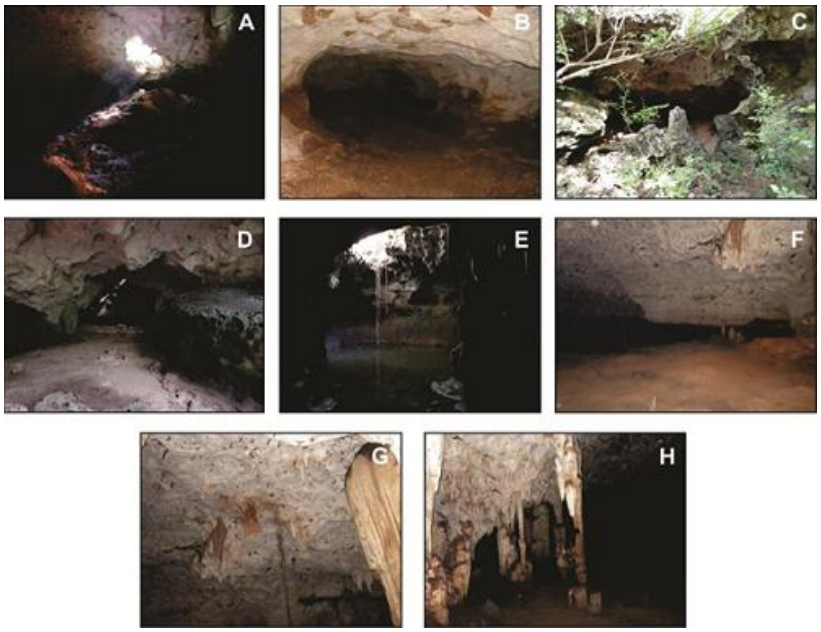

Figure 2. Galleries from cave La Barca, Guanahacabibes, Pinar del Rio, Cuba. Multiple entrances (A-D) and guano swamps (E, F, H).

Table 1. Number of sound files obtained on each field trip during the course of the project; these numbers include both recording systems used (Song Meter and Avisoft).

Field Trip (Date)	Number of sound files recorded
February	1 524
May	2 960
June	1 623
September	3 843
October	5 393

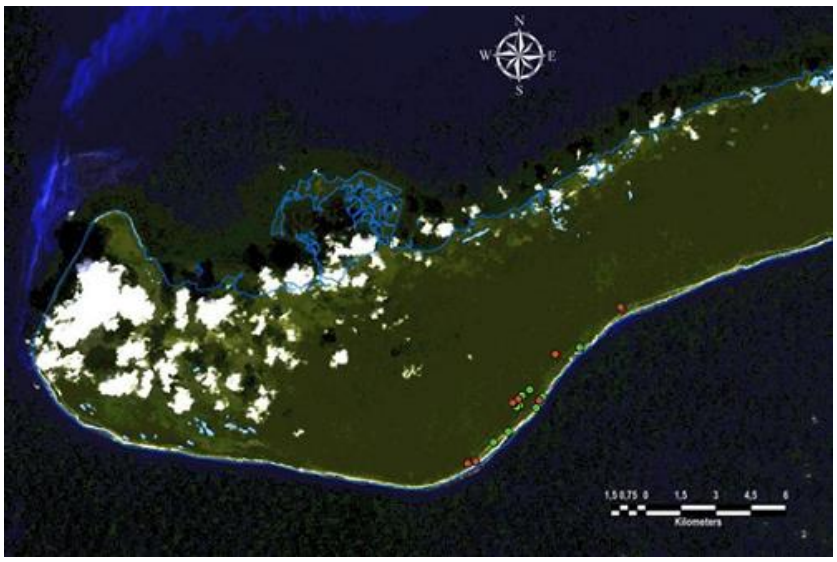

Figure 3. Places recorded to search the foraging zones of *Natalus primus*; colours represent acoustic recording locations from two different field trips to Guanahacabibes Peninsula, Pinar del Rio, Cuba.

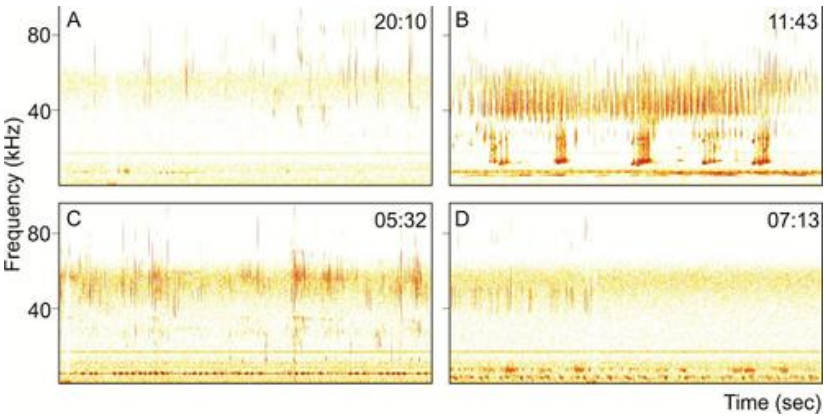

Figure 4. Spectrograms from sound files recorded in different times within one night of acoustic recording. Echolocation calls are within 40 and 80 kHz. Notice the difference in bat activity (denoted by the number of echolocation calls) in these hours.

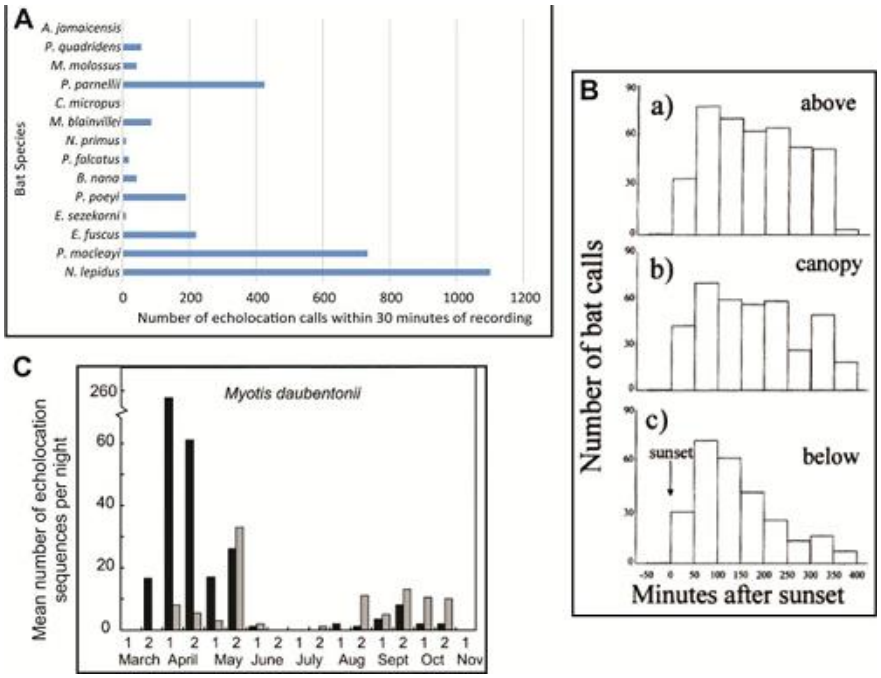

Figure 5. Bat species identified through their echolocation calls within 30 minutes of continuous recording (**A**). Bat activity measured after sunset in different environments (taken from Kalcounis *et al.*, 1999) (**B**). Bat activity measured through a whole year for *Myotis daubentonii* (taken from Furmankiewicz and Kucharska, 2009) (**C**).

Figure 6. Activities developed with forest rangers from Guanahacabibes National Park, these included an interchange of our results (**A**) and general knowledge about bats (**B**).

Figure 7. Activities developed with children from the community within Guanahacabibes National Park. We thought the main issues affecting bat populations and essential knowledge about them through interactive games (A and C).

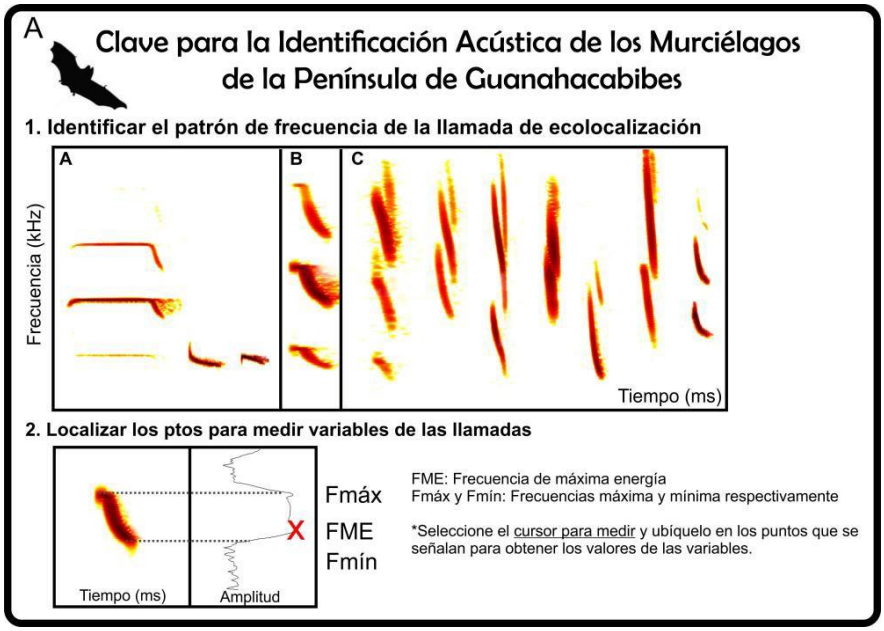

Figure 8. Echolocation Call Identification Key. (A) Spectro-temporal patterns from echolocation calls of Guanahacabibes National Park and some call variables to be measured on BatSound. (B) Values from these call variables described previously for these species.

Figure 9. Poster summarizing the main results achieved in the project

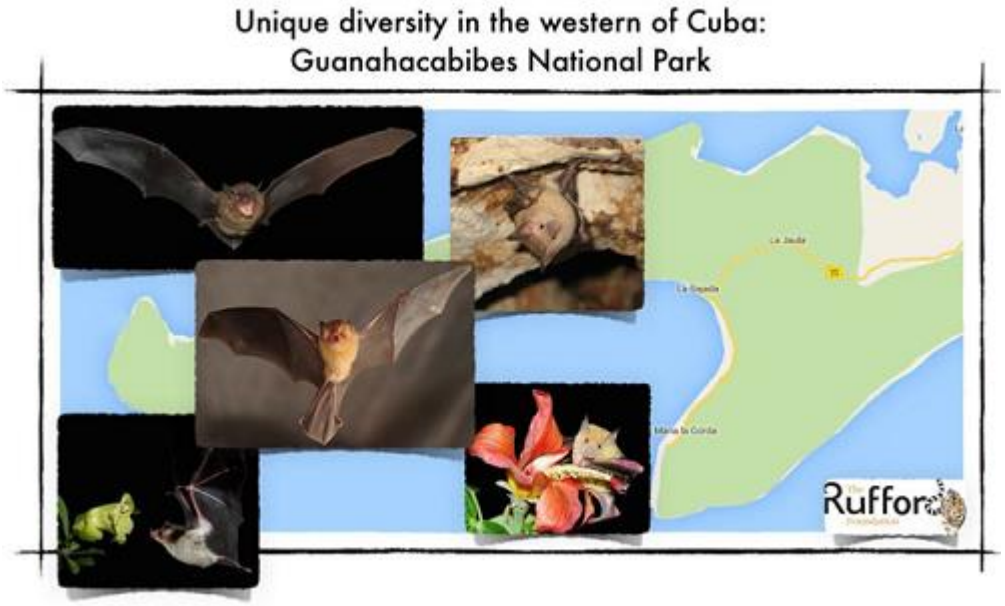

Figure 10. Poster to promote bat diversity in Guanahacabibes National Park.

Figure 11. Tshirts designed to promote bat conservation in Guanahacabibes National Park.

Literature cited:

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