Final Evaluation Report

Your Details	
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Project Title	Population dynamics, genetic-phenotypic variation of the bat *Tadarida brasiliensis mexicana* (Chiroptera: Molossidae), in Cueva San Francisco, Chiapas, Mexico
Application ID	25161-1
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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
Landscape Characterization				Initially, we had proposed to characterise the landscape and make captures of the Mexican free-tailed bat at various points, within a radius of 50 km from the CSF, in order to identify important areas for the foraging of the for *Tadarida brasiliensis mexicana*. However, this objective was not methodologically feasible, since it was difficult to sample monthly at various sites, and this required more staff, field expenses and more sampling.
Estimate size and composition of the colony of *Tadarida brasiliensis mexicana* at the CSF				From the thermal images we intended to use advanced technology to estimate the size colony (number of individuals) of *T. b. mexicana*. We tried to find the financing to buy an infrared camera, but this was not possible. Therefore, we bought home night vision cameras, but we did not get the proper images to estimate the size colony. Instead, we used the relative abundance (number of individuals captures per unit of effort) and recorded the duration of the emergence flight (DEF) per month. Although the colony size is not estimated with the relative abundance and DEF, these methods describe fluctuations in colony size throughout the year, which allowed us to hypothesize about the migration of *T. b. mexicana* at the CSF. From February 2018 to November 2019, we carry out monthly observations and bat captures with a mist net of 12 x 2.6 m to measure the relative abundance, DEF and determine composition colony (age,

				sex ratio, reproductive condition).
Analyse the phenotypic variation of *T. b. mexicana* at the CSF				We had no complications to achieve this objective. Five phenotypic characters of 1,571 captured bats (from February 2018 to November 2019) were measured: body mass, wing aspect ratio index, wing area index, wing loading index and wing tip index.
Analyse diversity and genetic structure of *T. b. mexicana* at the CSF.				We had no problem achieving this objective; however, financing was a limitation. Wing membrane biopsies were obtained from 1,818 bats, and we had planned to analyse samples from 360 individuals, however due to lack of funding, we only analysed samples from 126 individuals, which allowed us to achieve the objective without any problem. With 126 samples we amplified approximately 450 bp of the mitochondrial D-loop, and six microsatellite loci, making it possible to analyse the diversity and genetic structure of *T. b mexicana*.
Community training workshops and environmental education.				This objective was difficult to achieve because not all people showed availability and interest to participate in the workshops. However, we were able to identify a group of accessible and enthusiastic people to participate in the workshops. This group has had initiatives to promote activities and actions to restore and care for the cave that are not harmful to the bats.
Apply interviews				People who live closer to the CSF are more accessible to provide information and tell stories about the cave. Instead, people living in the village (about 900 m from the cave) are more reserved or not so optimistic about talking about the cave and the bats.

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

One of the most important difficulties we faced was not having the financing to buy an infrared camera, so we did not achieve the objective of estimating the size colony of *T. b. mexicana* at the CSF. The cost of this type of camera is quite high, and we could not cover it with our own sources.

We contacted a group of speologists and residents of the CSF to enter the cave, with the objective of observing where the bats perch and know more about of ecology of the bats. However, this was not possible, as access to the interior of the cave is difficult due to the sewage flowing into the cave entrance, which requires not only trained personnel, but also personal protective equipment and security necessary to enter.

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

1. Sampling of bats: during 2 years of field sampling, important data were obtained on the fluctuations in composition and size colony of *T. b. mexicana* at the CSF. Metrics on its alar morphology, and biopsies of the alar membrane were obtained with which its diversity and genetic structure were analysed. The foregoing is of great relevance to know the current status of this migratory species of bat in its southernmost known refuge, which in turn allowed us to infer about it´s possible migrations.

2. Community training workshops and environmental education. Workshops and meetings were held where the importance of the species of bats, birds and other mammals that inhabit the CSF was made known, which motivated to local community to continue participating in the safeguarding of the cave. Likewise, a group of people interested and enthusiastic in caring for the cave was identified, who could serve as leaders for the conservation of the native fauna of the CSF. However, these people require advice, training and monitoring to complement their conservation actions.

3. Crucial points that need tracing were identified: (a) although we focused on monitoring the Mexican free-tailed bat, we captured and identified all species of bats catched with the mist net. However, during the 2-year sampling we captured only six species of bats (with low abundance), out of 16 species previously registered for the CSF (in 2008), therefore, Do the other previously recorded bat species occasionally occupy the CSF and to a lesser extent with respect to *T. b. mexicana*, so they are not easily caught? Or, Has the wealth of bats in the CSF declined in recent years, as a possible consequence of the sewage flowing into the cave and the misuse of the cave (e.g. religious ceremonies)?; (b) It is necessary to enter the cave to identify specific roosting sites, as the CSF is likely to host different groups of bats (which come from different sites) during the year. If these separate groups were found inside the cave, it would be important to monitor each group, and obtain samples for subsequent molecular studies where the genetic relationships between them

were tested, and identify the possible risks and conservation priorities of each group.

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

Reports of the activities carried out in the CSF were delivered to the community representative, which included photographs, description and ecological/biological importance of the species reported in this study. This information will be of great relevance for future studies, and for the local community to have access to information on the species that inhabit the CSF.

Sometimes people from the local community accompany us during the fieldwork, which allowed them to learn more about the sampling of bats, and other species, as well as the importance of the cave for the native fauna. Due we paid local guides; some people of the local community benefited financially from the project.

Likewise, the community training workshops, and environmental education provide a mutual benefit, since the local community knows the importance of conserving, caring for and protecting the fauna of the CSF, and we learn from the local community.

Mexican free-tailed bats perform spectacular night-time emergencies every day, mainly at specific periods (identified in this project), so the CSF could be a tourist attraction where the survival and conservation of bats is not affected, and where the local community would have an economic benefit. Therefore, it is necessary to follow up the project, including advice to the local community and establish for the cave management plan to achieve nature tourism and the conservation of bats at the CSF.

5. Are there any plans to continue this work?

Of course, as we mentioned in question 3, important points that need follow-up were identified. The CSF presents conditions that endanger the safeguarding and conservation of bats (e.g. wastewater that empties into the cave entrance), but it also has the potential to be considered a special protection area, and therefore requires a lot of work in biological monitoring, environmental education, training for the group of conservation leaders, and specific long-term conservation strategies.
In the first instance, it is necessary to find the necessary financing sources to continue with the project, so we are already working on it.

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

The results of this project will be shared with the general public and with the scientific community through three scientific articles published in international journals, one of which is under review by *Mammal Research* journal, and we continue to work on the others two manuscripts. Additionally, a final report was delivered to the corresponding authorities of the community local of the CSF.

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

We used The Rufford Foundation grant for 19 months of sampling (boxes marked in gray). Initially, we had proposed that the project period would be from July 2018 to June 2020, but we decided that the most convenient thing to do was to start as soon as possible, and the project period changed from January 2018 to December 2019.

	Pilot visits	Field work	Environmental education workshops	Laboratory work	Data analysis
2018					
January	X				
February		X			
March		X			
April		X			
May					
June		X	X		
July		X			
August		X			
September		X			
October		X			
November		*			
December		X			
2019					
January		X			
February		X			
March		X			
April		X			
May		X			
June		*			
July		X			
August		X		X	X
September		X		X	X
October		X		X	X
November		X		X	X
December			X	X	X

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
Miscellany (Didactic materials)	121	190	+69	Miscellaneous expenditure was more expensive than expected.
Lodging	1363	1330	-33	The house rent for the work team to stay during the project activities was more expensive than initially budgeted. However, it had been budgeted to rent the house for 24 months, but it was rented for 19 months.
Subsistence payments for local team (field guide)	1363	816	-547	It had been budgeted that the sampling would be carried out for 10 days per month, but we made an adjustment to the activities, and the days sampled per month were reduced and therefore, it was required for fewer days to field guide.
Material and equipment	254	647	-393	Due we had difficulty obtaining quality films of the bats' emergence (with which the size colony would be estimated), we opted to purchase another homemade infrared camera (in addition to the camera that was donated by Idea Wild), as well as auxiliary infrared lamps and rechargeable batteries. Additional material was also purchased as requested, such as surgical and leather gloves to handle bats and mist nets (for personal health and hygiene, and protection and safety) and vial storage boxes (where bat tissue samples were kept).
Fuel	341	966	+625	The vehicle we used for field

				activities used more gasoline than was budgeted. In addition, fuel had been requested for 12 months of sampling, but this budget item was used for 19 months of project activities.
Food for team	1454	1700	+246	Sampling days per month were reduced, according to what was originally budgeted and planned. However, food was requested for the work team for 12 months of sampling, but this budget item was used for 19 months of project activities.
RUFFORD TOTAL	**4896**	**5649**	**+753**	
Vehicle maintenance		350	+350	
Genetic analysis		3959		
Total Project Budget	**4896**	**9958**		

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

- Continue the good relationship with the local authorities.
- Continue with the monitoring of bats in the CSF, identify when and what species of bats occupy the cave, and evaluate if the richness of bats has been affected in recent years.
- Identify the specific sites that bats use inside the cave, to know more ecological aspects of *T. b. mexicana*, and other species with which it shares the cave.
- Train, advise and monitor the group of previously identified people, who will serve as conservation leaders in the CSF.
- Establish environmental education and conservation programmes to municipal authorities so that they know about the serious problem of wastewater in the CSF, and this contributes to better measures of these wastewater management at the CSF.
- Establish specific conservation strategies at the CSF.
- Promote that the CSF is considered a priority area for the conservation of bats by the Red Latinoamericana para la Conservación de los Murciélagos.
- There are several research questions that must be answered, so it is necessary to continue the project.

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 use the logo in the presentations of the environmental education workshops and in the progress presentations to the work team (the Steering Committee).

Additionally, The Rufford Foundation will be mentioned as the main source of funding in each of the scientific articles derived from this project.

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

Mc.S. Viridiana Llaven Macías: project leader, and main social link between local authorities and the team; perform field methodological design, sampling, workshops, data analysis and project products (manuscripts).

Ph. D. Lorena Ruíz Montoya: academic tutor, directed the project, perform field methodological design, and collaborator in the redaction of documents.

Ph. D. Celia López González: academic advising, perform field methodological design, and collaborator in the redaction of documents.

Ph. D. Yessica Rico Mancebo del Castillo: academic advising, perform field methodological design, and collaborator in the redaction of documents.

Ph. D. Eduardo Naranjo Piñera: academic advising, perform field methodological design, and collaborator in the redaction of documents.

José Gerardo Domínguez Vera: logistical support in field activities and workshops.

12. Any other comments?

We only got funding from The Rufford Foundation, and some equipment and materials by Idea Wild, so we had to make budget adjustments to use the Rufford grant on all field activities, in addition to our own economic sources.

We appreciate the financial support given by The Rufford Foundation to our project.