The Rufford 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	Daniel Zamora Mejías
Project title	Effects of life-history traits on parasitism in the Mexican Long-nosed Bat and Lesser Long-nosed Bat in Mexico
RSG reference	21906-1
Reporting period	2017-2018
Amount of grant	5000 GBP
Your email address	dazamoram@iecologia.unam.mx
Date of this report	20-07-2018

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 Conduct field work for along distributional path of Long-Nosed bats in Mexico from August 2017 to June 2018.				The field work was conducted without any problems at all the proposed caves, except by Chamela-Jalisco, by the time we expect the colony of bats been present there, I was informed by colleagues that bats were not there. I manage to solve this situation by adding ahead of time three more caves (Los Laguitos cave, Chiapas, Grutas de Juxtlahauaca, Guerrero and El Salitre Cave, Morelos (Figure 1).
Obtaining a minimum 500 parasite samples from Lesser Long-nosed Bats in Mexico to do genetic and morphological characterization.				In total, I accomplished the sampling of parasites from over 509 bats from 10 caves. Our sampling corresponds to 5737 individuals of two species of Batflies (Streblidae: *Nycterophilia coxata*, n=2909 and Trichobius *sphaeronotus*, n= 2828) and 1678 wing mites Spinturnicidae: *Periglischrus paracaligus*. For more detail see Figure 2, 3a, 3b, 3c)
To record the physical factors and their effects on the host-parasite system in order to compare similarities and differences in parasitic loads on Long-nosed bats along their migration path in Mexico.				We recorded physical and biological variables without any problems (including temperature, relative humidity, parasites pupal deposition patterns). I am in the process of developing the most fitted model (using Generalized Linear Mixed Model) that explain the most important variables associated with the parasitism on long-nosed bats.

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

During the proposed dates to visit the cave at Chamela, Jalisco I was informed by colleagues that bats were not there. This might be explained by stochastic factors as

rain patterns might change the flowering timing of the plants. I managed to solve this situation by adding ahead of time three more caves (Los Laguitos cave, Chiapas, Grutas de Juxtlahauaca, Guerrero and El Salitre Cave, Morelos) to get the sampling done. Also we use information of locals to visit caves nearby the localities previously proposed, in this manner I was able to corroborate and include in the list La Mariana cave, Hermosillo, Sonora, previously documented by a colleague (MSc. Omar Calva) member of Unión Mexicana de Agrupaciones Espeleológicas (UMAE) as a new roost of lesser long-nosed bats.

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

1- I was able to obtain a good amount of samples from the long-nosed bats in the different caves visited. These samples will allow me to explain how the effect of biotic and abiotic factors in bats life cycle influence parasite transmission and the importance of stochastic factors favouring patterns of spatial movement. This information is highly necessary to improve managing actions and helps other actors involved as agave harvesters (tequila and mezcal producers) and communities (cultural uses as associated bat/cave tourism).

2- Preliminary results show that there is not a significant differences among parasitic loads, genetic/morphometric variation in long-nosed bats. In other words, at least implies that bats are moving with success along migratory paths and have interactions (e.g. mating) between subpopulations which increases genetic exchange and for instance good resistance/tolerance to parasites and pathogens.

3- For the first time we have obtained the DNA sequences for the wing mite parasites of long-nosed bats, this is very important because most of the information of this topic comes from studies in Europe on very different species. This information is a work in progress that will allow me to infer information on bats historical distribution, response to climate and habitat change, parasites speciation/adaptation/resistance that might be applicable to conservation efforts.

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

During the field visits to caves nearby local communities we did two different activities:

1- Informal participation of people during sampling, locals approach to us with curiosity and me and my team share with them information and personal experiences about bat ecology, ecosystem services and why it is important to preserve bats and the ecosystem services they provide (important information for present and future ecotourism projects they have).

2- We developed workshops at high schools (COBACH, Sonoyta, Sonora) for showing teachers and students what we are doing (and how do they can get involved in order to help and understand bats needs) and these workshops were

complemented with activities and games to reinforce information. In total, we give this workshop to approximately 85 students (Figure 4).

We also reunite the Pinacate reserve's team and biologists in order to share information about the project and bat's generalities, providing them with educational materials and activities planning for the museum, bat's handle and ID training. For educational materials and activities planning, we had the support of Bioconciencia A.C.

5. Are there any plans to continue this work?

Yes, I still have one more field visit to Chamela, Jalisco where I was unable to sample this year, and sample in other localities as Aguacatitla and Tziranda caves, Hidalgo State (Figure 1). Also, in collaboration with speleological researches of Sonora members of "Speleological Group of Sonora", we expect to design a monitoring strategy for this roost, located in San Miguel de Horcasitas, Hermosillo, Sonora State. This roost turn out to be a maternity roost for lesser long-nosed bats, and we documented at least five more species of bats using this roost, for instance, the importance of monitoring and developing a conservation managing plan is critical for the survival of bats and by extension the preservation of the ecological services they provide and at the same time describe in detail what is going on in that cave. We al

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

Partial results of this research have been already presented at one international conference at the II Latin America Congress of Bat Research, Latin America Network for Bat Conservation (RELCOM) in the Republic of El Salvador, in November 2017. Additionally, I plan to participate in one or two scientific conferences related to my field of study.

Also, my results will be shared in two or three scientific papers at the end of my PhD dissertation and in our laboratory blog called "La Huella del Jaguar" (The jaguar footprint) where I have already published of this project as well. At the same time, in agreement and collaboration with personnel from Biosphere Reserve El Pinacate, Sonora, we had developed a plan to share information, educational materials, pictures and videos that will hold at their Natural History Museum to be used on their educational programme.

I am also planning to continue collaborating with the Mexican Program for Bat Conservation (PCMM) and Bioconciencia A.C. with environmental education workshops. In all the described activities, RSG will be properly acknowledged.

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 as described for 2017 field work and January to June 2018 field/laboratory work as in the original time plan of my proposal with no major

changes to the schedule. All activities for which the funding was used are embedded in the second year of my PhD which mostly includes field work and the starting of laboratory activities and first results achieved. Still, more time needed to complete the overall objective of my doctoral project.

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
Lodging on field sites	1000	1092.17	92.17	All expenses went according to the plan. Even though I visited more caves than originally proposed, I have to thank colleagues for their hospitality at some of these places.
Food on field sites	1400	1550	150	For security reasons at some locations I increase the number of field assistants or hired local guides that increase the amount expended on food but was covered from my personal stipend.
Local Transport	1200	1279.74	79.74	Since we visited more caves the amount is higher but was solved with personal stipend funds and lots of help from colleagues and local guides.
DNA analysis	1400	1400	0	All expenses went according to the plan.
Total	5000	5321.91	321.91	1 GBP = 24.80 MXN pesos.

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

The next step is to assess the impact of parasitism on other species of bats and use this information to enhance conservation efforts contemplating more issues about bats' life cycles, disease transmission and bat resistance to pathogens and parasites. We are also looking ahead to design a monitoring strategy and developing a conservation managing plan as a critical step for the survival of bats for the new maternity roost discovered in San Miguel de Horcasitas, Hermosillo, Sonora state.

Also, we came across with new discoveries; I have found an interesting hyperparasite (a parasite of parasites) of batflies growing on some of the batflies (Figure 2D), of which we don't know much yet but we will work on that in the coming months.

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

I used the logo in the oral presentation in the international conference at the II Latin America Congress of Bat Research, Latin America Network for Bat Conservation (RELCOM) in the Republic of El Salvador, in November 2017. I have also used the logo from the presentations made during the workshops. The RF logo was displayed on the title slide and acknowledgments and the foundation was verbally acknowledged. Also, I have recommended the Rufford Foundation as an option for researchers and students who have asked for my advice in order to look for funding for their projects. Also will be listed on the PhD investigation thesis and future congress activities.

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

Prof. Dr. Rodrigo Medellín, **Prof. Dr. Juan Bibiano Morales Malacara**, and **Prof. Dr. Bernal Rodriguez-Herrera** as a part of my Ph.D. the committee, they have given their guidance and expertise to the project, increasing the success for all steps of this project.

Dra Laura Navarro member of Bioconciencia A.C has been a keystone in the success of the educational workshops we have given.

I am also grateful to **National Commission of Protected Areas** (Comisión Nacional de Áreas Naturales Protegidas, CONAMP, Mexico) and the team members at Biosphere Reserve El Pinacate y Gran Desierto de Altar in Sonora Mexico for all the logistical help in that beautiful but also challenging place to work.

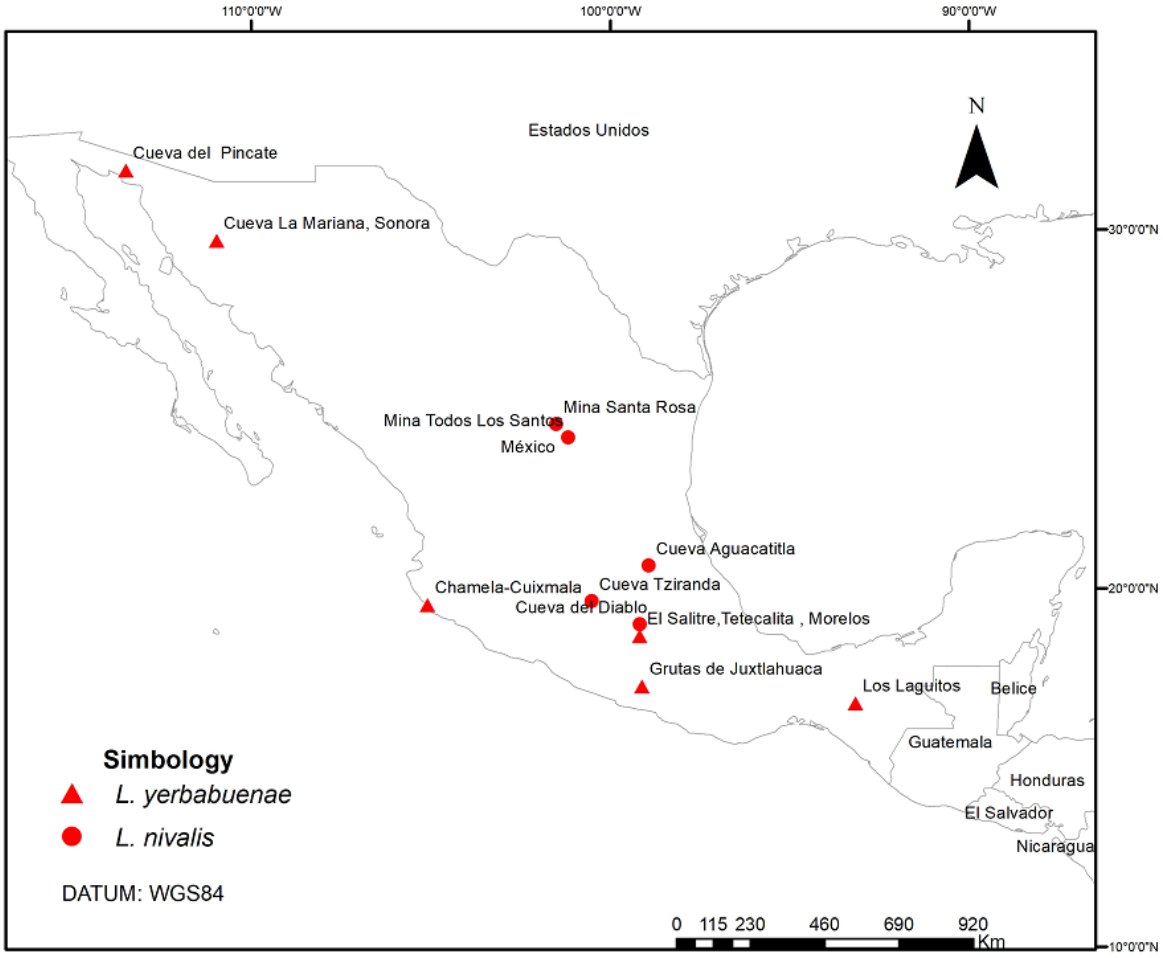
And finally, **Mirna Salas Moya** who has been a strenuously and hard worker field assistant, her knowledge and unbreakable spirit made possible the successful accomplishment of field work.

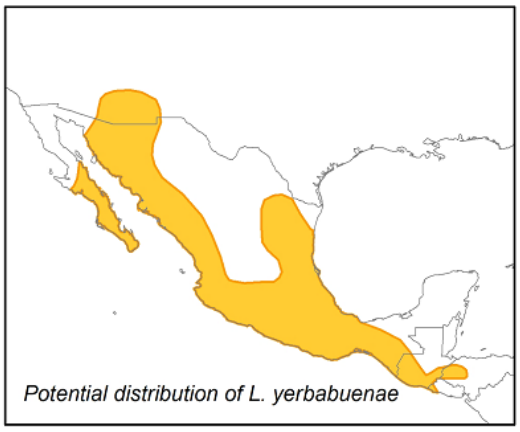
12. Any other comments?

This study working with long-nosed bats has been challenging especially because Mexico is a big country and bats move all over it, their importance to the economy and the cultural value of this species deserves more efforts to conserve them. But also I have learned about science, about myself, about other people and about this amazing country and its complex cultural aspects that might help to the development and reinforce conservation activities. Working in a country as big as Mexico demands a lot of effort in the field but also gives a lot of satisfaction when

the work is done, and when you witnessed magnificent caves, amazing sunsets, and incredible dawns.

All this learning, novel results and new information gathered has been possible thanks to the RSG foundation for the funding provided for my project!





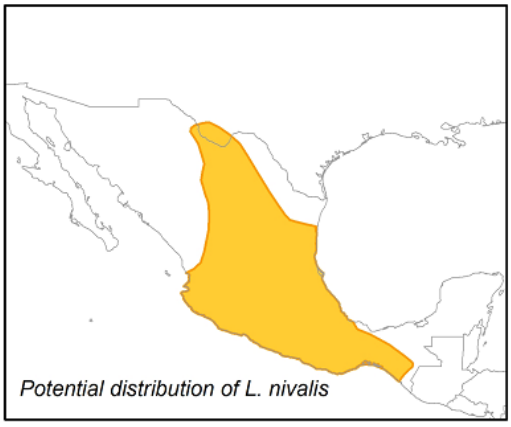


Figure 1. Sampling locations in Mexico and the potential distribution of Long-nosed bats species.

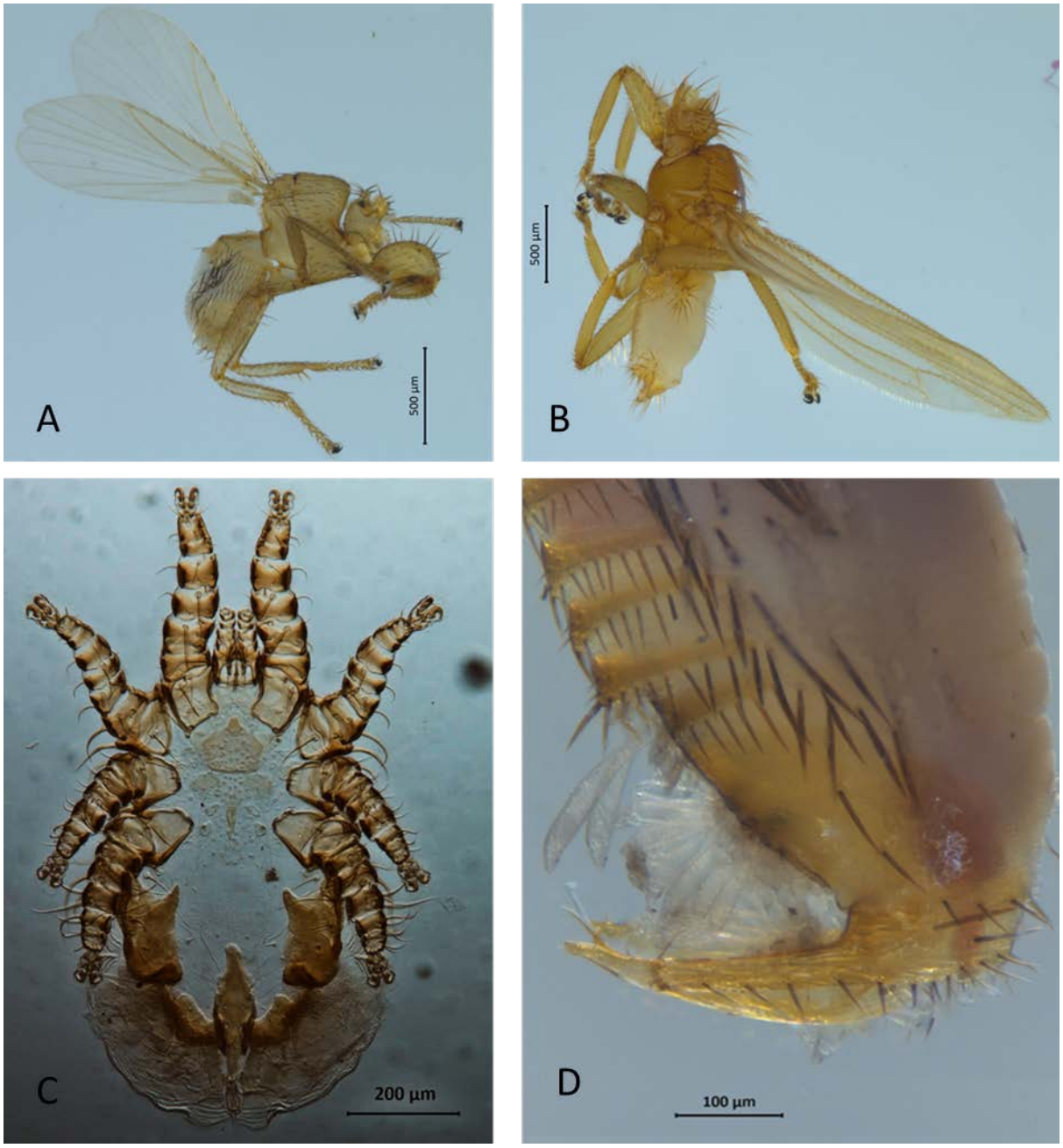


Figure 2. Ectoparasites of Long-nosed bats sampled in this study. A- *Nycterophilia coxata*, B- *Trichobius sphaeronotus*, C-*Periglischrus paracaligus*, D- Hyperparasite of batflies (Laboulbeniales fungus) on sexual parasite's structures. Pictures were taken with a phase microscope (ZEISS Axio Zoom.V16).

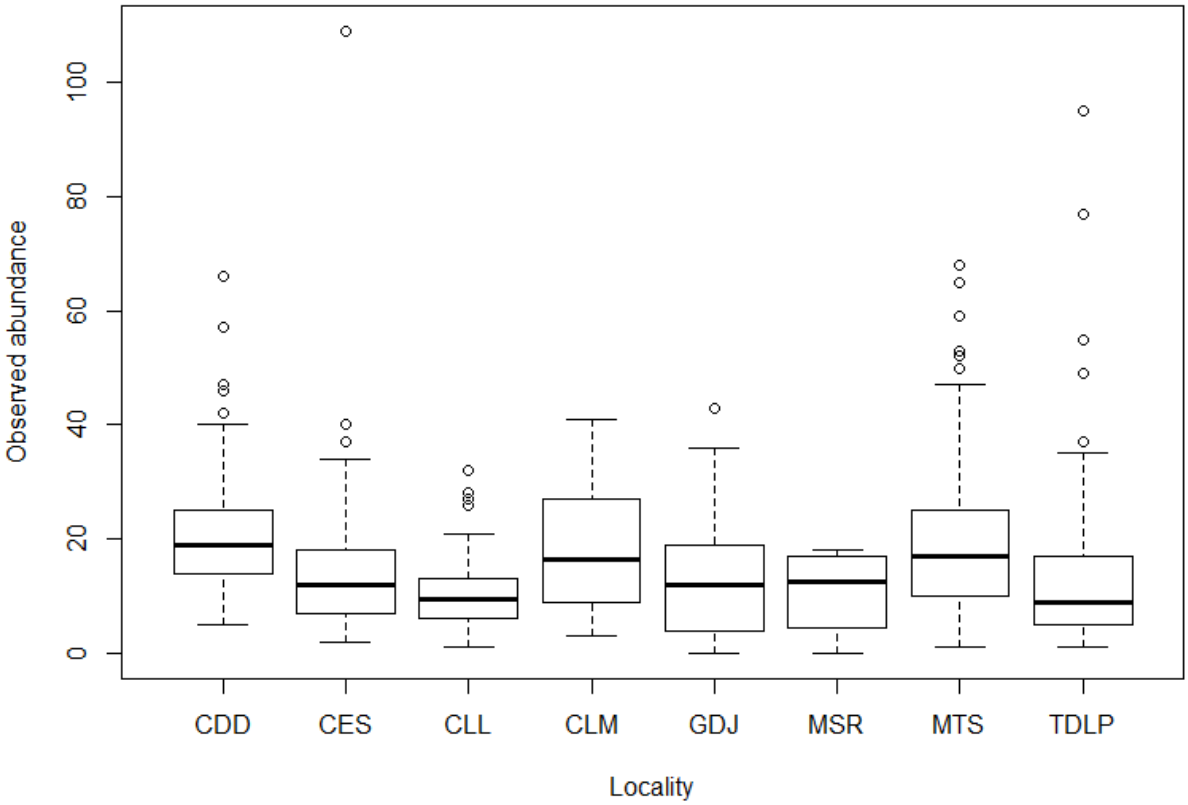


Figure 3. Total abundance of ectoparasites (n=7415) sampled on Long-nosed bats by locality sampled (CCD=Cueva del Diablo, CES=Cueva el Salitre, CLL=Cueva Los Laguitos, CLM= Cueva La Mariana, GDJ=Grutas de Juxtlahuaca, MSR=Mina Santa rosa, MTS=Mina Todos Los Santos, TDLP=Tubo de Lava Pinacate).

Figure 4. Students and kids participating at bat workshops.

Figure 5. Informal talks about bats, we inform people that approaches us about bat's importance to humans and why we need to conserve them. In this Picture Mirna Salas Moya, field assistant and two kids from the neighboring community, Cueva del Diablo, Morelos.

Figure 6. A- Mist net setting at Pinacate Cave, Sonora, B- Our field team at Cueva la Mariana, C-Group of Long-nosed baby bats, mothers are out foraging, D- Social (and dog) interaction during feeding stop nearby Sierra La Mojonera, Zacatecas.

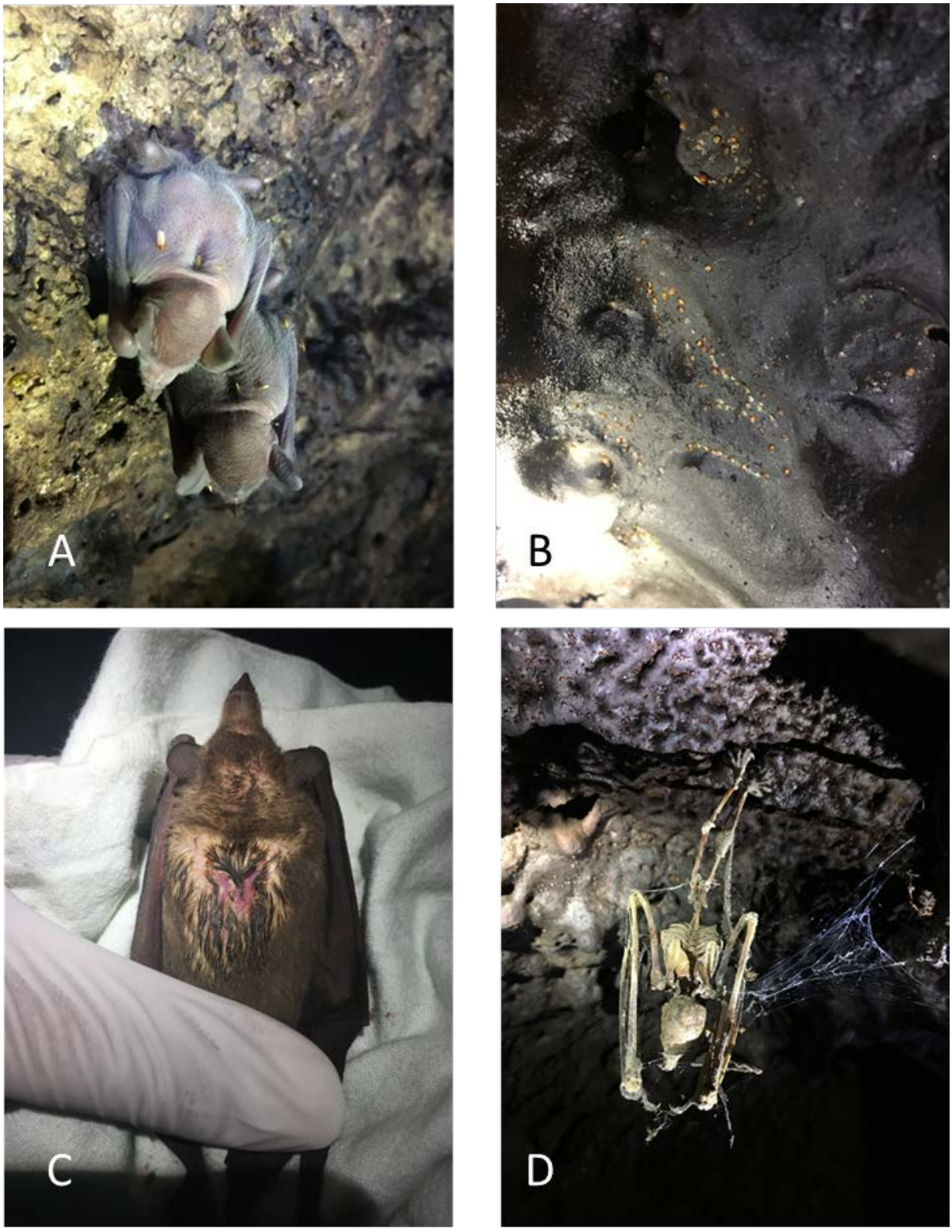


Figure 7. A-Couple of young's of Lesser long-nosed bats with batflies on their backs, B- Batflies pupae attached to the cave walls, when they hatch they look for a bat in order to get its first blood meal, C- Lesser long-nosed male bat showing a back patch, D- A dead fellow bat still hanging from the cave's wall, this is part of the natural cycle inside the caves.

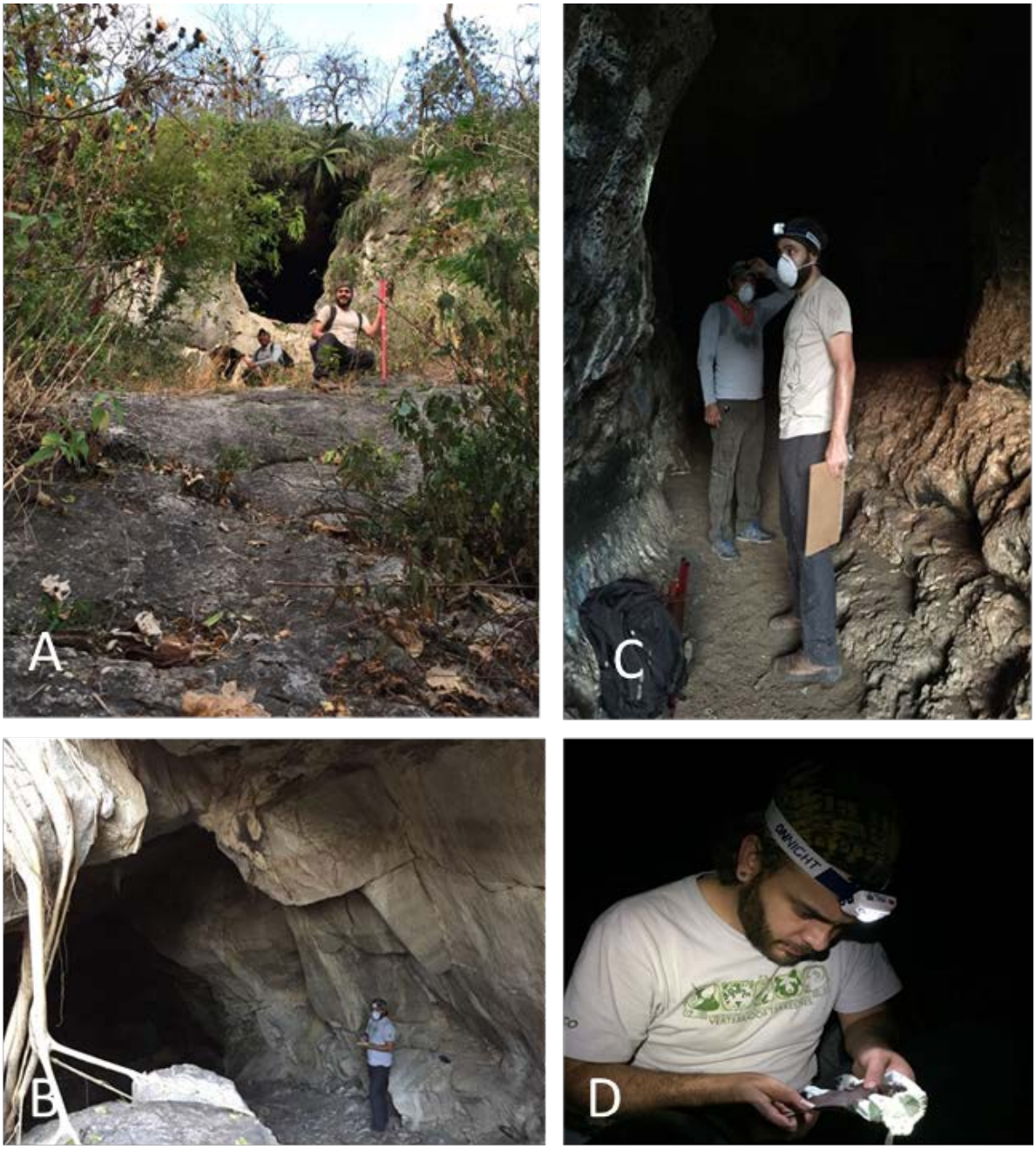


Figure 8. A, B- A local Guide “Kike” and me at the entrance of Los Laguitos cave, Chiapas state, C- El Salitre Cave, Morelos state, D- Prospecting bat ectoparasites.