The Rufford Small Grants Foundation

Final Report

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

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. 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. 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	Veronica Zamora Gutierrez
Project title	Estimating the effects of land use, climate change and protected areas on the conservation of bats
RSG reference	12059-1
Reporting period	June 2012 - May 2013
Amount of grant	£5850
Your email address	vz211@cam.ac.uk
Date of this report	6/09/2013

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
Follow a regular and equal-stratified methodology with a detailed environmental gradient to improve bat occurrence data			X	Historical bat records suggested that bats might not be present in an extended geographical area in Mexico and results from my field work reject this hypothesis. Arid and semi-arid regions in Mexico host a considerable abundance of bats and there are important regions to be considered in conservation plans. I did my field work in a stratified sampling strategy based on environmental clusters with areas that share climatic similarities. This strategy was successful, and I was able to cover as much geographic extent with the least time and money. Analysis of inventory completeness showed that common species were effectively represented in the samples in most environmental units.
Complement the existing information on bats species occurrences to reduce the biases on which conservation decisions have been made in the past.			X	
Record bat calls and start assembling the first national bat acoustic library.			X	I recorded during field work a total of 811 individuals belonging to 40 species and 6 families. In addition, other researchers shared their unpublished material for the purposes of this project. Thus, to date this is the biggest and most complete bat acoustic reference library for Mexico.
Develop an automatic identification tool		X		The next step is to use the material from the calls library to build the ID identification tool and apply it to the free bat recordings. I am still working on this. This objective was partially completed because I could not get enough reference calls from tropical bat species thus the tool will be developed only for bat species distributed in the Nearctic realm.
Improve the robustness and accuracy of single-species distribution models with more data collection		X		The data I collected is an important independent data set to test the prediction of my distribution models. Only few studies have had the opportunity to test model predictions in independent data sets. Free bat recordings still need to be analysed and I expect that results will further improve occurrences for several
Provide new information to develop predictive models of species occurrences to direct future research into areas		X		

and species still poorly understood.				species. However, partial results highlighted the importance of areas still unexplored to be included in conservation assessments and as priority points for further explorations.
Develop new and more accurate maps at high resolution (10 km and 1 km) of bat species distribution in Mexico		X		I am still working on these objectives and they are the final stage of my PhD project. The data collected will be implemented here and will contribute to all these points.
Get a better understanding on how current bat species distributions will be affected by different scenarios of climate and land use change in Mexico		X		
Generate information and maps that will provide crucial information to decision-makers to better manage landscape dynamics		X		
To direct the design of new reserve networks so that existing reserves have an adequate representation of natural habitats that could be used as future refuges for bat species		X		

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

I found two situations that caused the sampling strategy to be re-structured, one of them was human caused and the other one was a result of natural phenomena:

A very unfortunate situation in Mexico is the security issue due to drugs dealers' conflicts. The original plan was to spread my sampling sites further away and include the states of Coahuila and Tamaulipas. However, dangerous situations forced me to restrict my sampling to a more reduced area where my students and I could be safe. The original idea was to spread sampling sites at least 100 km minimum distance but security reasons particularly near U.S.A. border reduced the distance between my sampling sites. This problem did not stop us and we only had to re-arrange our previous selected sampling areas into safer regions but we still manage to represent the climate and vegetation types previously selected, and we also managed to sample areas without any bat data. Thus, the new sampling strategy will not cause major changes in the performance of species distribution models.

The other situation that caused delays, equipment damage and put us in some risk was the weather. The year 2012 was unusual in rain dynamics. Some of the driest areas in the country like the Sonoran

Desert received heavy storms that lasted several weeks, it was probably the wettest year in the last 10 years according to other researchers (Medellin com. per.). There were also hurricanes and tropical storms that hit the country during the last months of the sampling period 2012. During this period, I did not use mist nets in several sites to prevent animal deaths and to avoid equipment damage. On the other side, this unusual weather kept temperatures relatively warm until late October and that helped me achieved the number of proposed sampling effort. Weather was also highly unusual during the second field season in 2013. Low temperatures extended until early spring and bat activity was quite irregular. Unfortunately, I could not extend sampling effort during this period because I had to return to my University, but I still accomplished to sample enough representative sites.

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

a) An independent data set: Species Distribution Models are influenced for a number of factors that do not necessarily reflect ecological characteristics of species but are more a methodological artefact. For this reason, it is important to test their prediction capacity with independent data. However, this type of information is usually unavailable because most of the times the only data available to model comes from historical records collected by other people with several biases. Some studies have shown that dividing occurrence data into training and testing sets does not provide real independent testing because both sets come from the same data pool with the same biases. Effective testing can be done only on data collected at different geographical spaces (e.g. other countries) or at different times (past or present). My set of new sampled sites represents good independent data to test my bat distribution models. This is not only important for my maps but also to increase the understanding about different methods accuracy and capacity to predict new data.

b) Generate data in unexplored regions: Testing for limitations or gaps in knowledge, such as sampling bias, can pinpoint geographical areas where further research is needed. Analysis of historical bat records revealed a paucity of information on bat distribution for an extended geographical area in Mexico. Special research and conservation attention are paid to those areas we consider most biodiverse and in greater extinction risk like the tropics. As a consequence, scientists tend to underestimate the importance of less studied ecosystem like deserts and other arid regions. I developed most of my field work in these habitats and bats are more common and abundant that we might think based only at looking at historical records. Ecosystems with extreme environmental conditions are a real challenge for researchers and animals as well. The adaptations and strategies that bats and other taxa must develop to survive are unique. Extreme climates challenge species and forced them to live at the edge of their physical equilibrium. Bats that inhabit these regions completely rely in two resources that are critical for their survival: water and roosting sites. By understanding how animals deal with these extreme conditions might help to better elucidate consequences of future climatic changes.

c) Ensemble a partial bat calls library and development of and ID Tool: The recordings made will contribute to a national bat call library, an important future resource for ecological and conservation applications. The library represents one of the biggest databases for Mexico bat calls. The Id tool I am developing could be used to identify species recorded in acoustic bat surveys and monitoring programmes over a large part of Mexico and possible Canada and USA since many species in those countries are shared with Mexico. The opportunity to standardise species identification in a way that is consistent, repeatable and easy through time and space will enable effective monitoring of

bat activity and distribution patterns. This will provide the bases to establish the first national acoustic bat monitoring programme in the near future when more calls for the library are available. The establishment of this monitoring programme will provide invaluable data on the status of bat populations and their responses to global change providing politicians, scientists and other stakeholders with the information necessary for effective national and international conservation strategies.

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

My study is not focused on improving any type of human welfare or in giving any sustainable alternative of natural resources use thus there is no direct human benefit from it. However, I consider I provide some environmental education to those places I visited, and I improve bat reputation in several locations. In every site I sampled, at least one member of the local community was curious about our work and approached out team to know more about it. Although the impact of this contact might not seem significant, the attitude of several people towards bats changed to a positive appreciation after they had a close encounter with these animals and after we explained their importance for ecosystems. Some of this site included important maternity bat colonies and we put special effort in talking with the owners of that land to encourage them in protecting those sites and not to disturb them. In addition, PRONATURA Noroeste (National NGO) actively participated in some of our expeditions. They work mostly with birds in several reserves in Northwest Mexico, so bat sampling was a new experience. The most important work I made with them was information exchange so they can include bats as part of their environmental education programs.

5. Are there any plans to continue this work?

Definitely I plan to continue with this work. I located important conservation sites that we didn't know about it and I want to place a monitoring site in those areas. I built good relationships with all the communities and owners of the sites we worked, and I plan to continue visiting them with better environmental education programs to build an effective bat conservation network in the arid regions of Mexico. I also started new collaborations with researchers of other institutions, and we are planning new expeditions to more unexplored sites not only for bats but also for other mammals groups. I also plan to apply results of this project to improve protected areas network in the arid regions in Mexico and to be involved in mining regulations politics.

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

I visited several protected areas without previous bat work. These are Cumbres de Majalca National Park, Flora and Fauna Protection Area Sierra de Álamos-Río Cuchujaqui and Campo Verde. Other reserves have a bat species inventory, but detectors have not been used before. These reserves are El Pinacate y Gran Desierto de Altar Biosphere Reserve pinacate (recently declared human heritage site by UNESCO), Valle de los Cirios los cirios Biosphere Reserve, Ajos Bavispe Forestal Reserve and Mapimi Biosphere Reserve.

I am confident that the detectors I used with full spectrum real time recording capacity will considerably improve bat species list in those areas. Once I analysed all the recordings, I will share the information to the managers of those reserves to be incorporated into their species lists. I will collaborate with them by suggesting important areas for bat conservation and adequate disturbance mitigation based on my general thesis findings. In addition, I found mines and caves that are not highlighted as important for bats but host thousands and possible millions of migratory bats, some of them are maternity colonies. I have been in contact with the landowners and I have provided suggestion to develop sustainable and bat friendly eco-touristic activities and other economic options besides land use change for cattle and agriculture. I will also publish the results of this work to make my findings available for the scientific community.

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

	2012							2013				
	Jun	Jul	Aug	S	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Planning First Field												
First Field Season												
Pre-Analysis of results												
Planning Second Field												
Second Field Season												
Visit to key universities												
National Mastozoology												

I used the RSG funding to complete my second field work season. If I should not have had that budget my sampling would have been limited to only one season.

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.

I made only two transfers from my UK bank account to my Mexican account to avoid losing money due to low exchange rates at different times. The average exchange rate was 1 GBP = 19 MXN

Item	Budgeted Amount	Actual Amount	Difference	Comments
Accommodation	2300	796	-1504	I got a lot of help from friends, colleagues and local people and we stayed for free in many places
Food	1800	2300	500	Food is more expensive in remote areas and in border cities. When we run out of food, we had to load our buttery wherever we could, no matter the price. Also, I needed an extra field assistance that was not previously considered.
Air ticket UK-MX-UK	1200	1213	13	
Vehicle and other transport	3100	5500	2400	I needed a 4x4 car which are much more expensive than conventional

				vehicles and big enough for 4 people and all the equipment. I was expecting to get a cheap vehicle in a border city but due to previous crisis in USA prices raised a lot here in Mexico as well.
Fuel and cost of private highways	2950	3026	76	
Car maintenance	950	1110	160	We had more breakdowns than expected
Equipment	510	2130	1620	I had to buy a photographic camera and spend extra money fixing two detectors that broke down. That implied customs costs and shipment because they had to be send to USA
Material and other consumables	950	630	-320	I bought the mist nets second hand which considerable reduced costs.
Song Meter Bat Detector	1000	1250	250	Price difference is due to customs and shipment.
Pettersson 1000x detector	5000	5000	0	
Working space and others	800	800	0	
Protected Areas	450	450	0	
TOTAL	**21010**	**24205**	**3195**	

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

From my field work experience I draw the next conclusions:

a) In areas where bats provide an economic benefit, people tend appreciated them more. Thus, bigger attention should be paid to guano as a new economic source for local communities in areas with great incidence of caves and abandoned mines. Locals should be informed about risks and the possible economic benefits for their communities if this resource is used in a sustainable way.

b) Bats that inhabit these regions completely rely in two resources that are critical for their survival: water and roosting sites. However, economic instability and market tendencies now pose a new threat to desert bats. Several mines unexploited for decades and now highly bat populated are being reopened and as consequences bat communities are been killed to re-open those mines. We are at a critical moment where strict mine regulations must be placed before transnational take the power without any environmental control.

c) Another important element we must take into consideration when managing landscapes and habitats for bats is freshwater availability. Surface freshwater is extremely limited in the arid and semi-arid regions. However, this resource it is more abundant (or was) in the subsoil. Overexploitation of groundwater aquifers in this region has reduced the quantities of running fresh water available in several essential rivers. Extensive use of fresh water for agriculture is causing the

substitution of freshwater aquifers by saline water. People do not realize that underground water has also a delicate equilibrium and is not and endless resource.

d) Following the previous point, oasis are a key micro habitat in arid regions that has not been assessed or studied in detail before thus we do not know their conservation status or if they might be in danger of declining, we are as well unaware of possible threats that might arise in the near future. Natural oasis must be identified in arid and semi-arid regions and placed under protection. We need detailed studies about the species that depend on them and which are the most critical season (reproduction, nursing, etc.) for each of them. Even cattle drinking fountains and any other water body, including artificial ones are key elements for bats and other species in this landscape. We could mitigate some of the impact we are doing through groundwater extraction if we placed simple but effective artificial water bodies across the landscape to help animals cope with disturbance and environmental changes.

e) Another problem identified in the region is the extension of intensive agriculture and a growing use of pesticides and artificial fertilizer. In the several informal talks I have with local people, many of them identified a link between the increasing use of chemicals in agriculture and a considerable reduction of bat populations. This is highly concerning since the most abundant bat species inhabit this region and we might think that due to their high numbers they might be out of declining risks. Also, because we have no previous data we are unaware of the magnitude on abundance changes. It is crucial to start systematic monitoring program to understand population dynamics in these regions to be able to identify these risks.

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

So far, I have made two presentations where RSFC logo has been used:

a) A presentation made to students from the Universidad Autónoma de Chihuahua, Mexico.
b) A presentation made during the International PhD curse “Modelling species distributions under climate change” at University of Copenhagen.