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. 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	Yara Azofeifa Romero
Project title	Consumption of pest insects and intake of pesticides by insectivorous bats associated with two agricultural systems in the Western Llanos of Venezuela
RSG reference	12366-1
Reporting period	Exploratory (April, May, June, August and September 2013) and fieldwork (November 2013 - October 2014) phases.
Amount of grant	£6000
Your email address	yazofeif@gmail.com
Date of this report	November 25th, 2014

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

[1]Objectives	Not achieved	Partially achieved	Fully achieved	Comments
(1) To identify the species of insect pests in crops of corn and rice in selected areas in the Western Llanos of Venezuela. (2) To determine whether there is variation in the abundance of pest insects during the phases of growth and development of crops of corn and rice.		x		Once we carried out an assessment of all grants obtained vs. the cost of the original project, we realised that we had to choose between rice crops or maize crops. Finally, we decided to work on two rice crops, for two reasons: (a) easier accessibility in the field, allowing us to reduce expenses to conduct the study; and (b) rice growers at Acarigua and Turén (Portuguesas state) of Venezuela showed particular interest in the project, and provided key logistic support that helped me to achieve my research goals. This goal was reformulated as follows: to determine species composition of pest insects in selected rice fields and changes in relative abundance during the dry and rainy seasons. The official beginning of the project was delayed for approximately 6 months due to the following reasons: (a) my Qualifying Exam was approved in mid-2013 and the defence of my project was carried out in late 2013; and (b) time delays in approval of the official permits (hunting licences for scientific purposes, capture permit of terrestrial invertebrates and access to genetic resources) to conduct the study precluded me to begin field sampling until September 30th 2013. We had difficulties in finding undergraduate and graduate students with expertise in entomology to help process the insect samples. This circumstance delayed the work of separation and identification of insects. Fortunately, we now have three people involved in this work. As a result, now we have the reference collection of insect pests for rice crops in the Western Llanos of Venezuela. We are gradually moving into the processing of samples of insects collected during the fieldwork.
(3) To determine the richness and relative abundance in species of		x		Because individual bats cannot be counted by acoustic methods, we decided: (a) to determine species richness; and (b) to quantify

aerial insectivorous bats present in the selected agricultural systems.				the general and feeding activity of aerial insectivorous bats. This goal was reformulated as follows: (a) to identify species and functional groups of aerial insectivorous bats associated with selected rice crops during the dry and rainy seasons; and (b) to estimate the feeding activity of aerial insectivorous bats in rice fields during the dry and rainy seasons.
(4) To identify the species of aerial insectivorous bats that consume the largest amounts of insect pests in selected crops.		x		We are finishing the bureaucratic procedures to get the export permit needed to transport fecal samples of insect-eating bats to Laboratoire d'Ecologie Alpine, Université Joseph Fourier, Grenoble, France, where I will conduct molecular analyses to infer the diet of bats using DNA barcoding. These analyses are scheduled for May 2015.
(5) To identify and to quantify pesticide residues in insects and insectivorous bats associated with rice and corn fields.	x			This objective was eliminated from the project, because we could not get the necessary funds for its development.

[1] Some logistical problems and lack of sufficient funds forced us to select two rice crops to conduct the study. However, in these field crops we took data during the dry and rainy seasons, thus covering two life cycles of rice in each study site (Acarigua and Turen, edo. Portuguese).

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

Convincing the rice producers about the importance of the project was not difficult; however, it was a bit more difficult to make the local communities to understand the importance of these mammals as providers of ecosystem services. This is due to the lack of information available to communities, a situation that causes actions of poisoning and destruction of natural refuges for bats. Gradually, through simple explanations, we gained the support and participation of the community in our project.

The second unforeseen difficulty was a substantial delay in processing and approval of the necessary permits to conduct the study. Because this research included bat captures, insect captures, and genetic analysis, we had to apply for different permits. The genetic analysis one was particularly difficult to get, because it included not only approval to analyse fecal samples, but also to ship them overseas (export permits).

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

Outcome #1: Insect pest species of rice crops reported in this study (Table 1) may be part of the diet of aerial insectivorous bats (AIB), because these insects can be easily detected by the sonar system of three functional groups (uncluttered space, background-cluttered space, background-cluttered space trawling insectivore) identified in this study (Table 2).

Table 1. Main species of insect pests identified in rice crops selected for the study.

Order (Family)	Species	Common name
Lepidoptera (Noctuidae)	*Spodoptera frugiperda*	Gusano barredor
Lepidoptera (Crambidae)	*Diatraea saccharalis*	Gusano taladrador
Lepidoptera (Crambidae)	*Rupella albinella*	Novia del arroz
Homoptera (Delphacidae)	*Tagosodes orizicolus*	Sogata
Homoptera (Cycadellidae)	*Hortensia* sp.	Loritos verdes
Hemiptera (Pentatomidae)	*Oebalus insularis*	Chinche vaneador del grano de arroz
Hemiptera (Pentatomidae)	*Tibraca* sp.	Chinche marrón
Hemíptera (Lygaeidae)	*Blissus leucopterus*	Chinche de la raíz
Coleoptera (Curculionidae)	*Lissorhoptrus* sp.	Gorgojo
Orthóptera (Tetrigidae)	*Conocephalus* sp.	Saltamontes del arroz

Table 2. Functional group and diet reported for AIB species captured in the ecotone and bat artificial shelters nearby two rice crops in the Western Llanos of Venezuela.

Species (Family[a])	Functional group[b]	Diet
**Molossus* (Mol)	US	Lepidoptera, Himenoptera and Coleoptera
Molossus sinaloae (Mol)	US	
Molossops temminckii (Mol)	BCS	Coleoptera, Lepidoptera, Hemiptera and Himenoptera.
**Eumops glaucinus* (Mol)	US	Flying insects
**Myotis nigricans* (Ves)	BCS	Flying insects
**Eptesicus furinalis* (Ves)	BCS	Flying insects
Rhogeessa tumida (Ves)	BCS	Flying insects
Lasiurus ega (Ves)	BCS	Flying insects
**Saccopteryx bilineata* (Emb)	BCS	Diptera, Lepidoptera and Coleoptera
**Saccopteryx leptura* (Emb)	BCS	Flying insects
Rhynchonycteris naso (Emb)	BCS-T	Diptera and microlepidoptera
**Pteronotus personatus* (Mor)	BCS	Flying insects
**Pteronotus davyi* (Mor)	BCS	Flying insects
**Pteronotus gymnonotus* (Mor)	BCS	Flying insects
Pteronotus parnellii (Mor)	HCS	Diptera, Lepidoptera and Coleoptera
**Mormoops megalophylla* (Mor)	BCS	Flying insects
Noctilio albiventris (Noc)	BCS-T	Coleoptera

* Species recorded while performing hunting activity

[a] Mol: Molossidae, Emb: Emballonuridae, Vesp: Vespertilionidae, Mor: Mormoopidae, Noc: Noctilionidae.

[b] US= uncluttered space; BCS= Background-cluttered space; HCS= highly-cluttered space; BCS-T = background-cluttered space trawling insectivore/piscivore

Taken from: [1]Estrada-Villegas *et al*. 2010, [2]Linares 1998.

Outcome #2: Based on our acoustic recordings, we can say that rice crop are important feeding sites for aerial insectivorous bats, because 10 species, 59% of total bat species identified by acoustic methods, were recorded while performing feeding activities (Table 2).

Outcome #3: Although we require of the analysis of all sound files and dietary analysis to determine whether an association exists between: (1) feeding activity of bats and relative abundance of pest insects; and (2) diet of bats and relative abundance of pest insects; in our exploratory study, we obtained evidence suggesting changes in relative activity of various species of bats throughout the rice's life cycle which might be associated with changes in relative abundance of pest insects (see Appendix 1)

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

During the project development, we had the opportunity to interact with different members of the community (children, young and adults), who voluntarily approached us to learn about the project. They realised that bats perform ecological functions that benefit us all and that their fears are unfounded. Many of them admitted having destroyed artificial and natural refuges of bats by ignorance, and they promised to not continue with that activity. In addition, there is great concern about conflicts caused when these animals occupy the roofs of their houses, because these people want to exclude them from their homes without causing damage to them.

Also some people in the community were hired as field assistants in the project, which has benefited them both economically and intellectually.

Finally, on of the two rice producers (Mr Daniel Sanchez and Mr José Luis Alvarez) that allowed us to work in his property, wants to help support workshops to communicate rice growers in Portuguesa state the importance of insect feeding bats as biological controls of rice pests.

5. Are there any plans to continue this work?

Definitely, we will continue the project until we conclude totally. After that, as result of our findings, the applied projects will emerge to manage and conserve bat populations associated with rice crops. Specifically, we want to apply to Venezuelan Government funds to develop a management project aimed to provide rice crops with artificial bat shelters surrounding rice crops and monitor: (1) bat colonisation time; (2) bat feeding activity comparing rice crops with and without artificial bat shelters; and (3) level of damage to rice plantations in crop fields with and without artificial bat shelters. We expect to prove: (a) substantially higher bat feeding activity above rice crops with artificial bat shelters; and (b) less damage to rice plantations in those crop fields.

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

We have already presented some results of the project in following scientific congresses:

1) X Congreso Venezolano de Ecología (2013): Poster entitled "Observaciones preliminares sobre murciélagos insectívoros aéreos asociados a dos cultivos de arroz en los Llanos Occidentales de Venezuela".

2) 1er Congreso Latinoamericano y del Caribe de Murciélagos, Quito, Ecuador (2014): Poster entitled "Llamados de ecolocalización y observaciones generales de *Myotis nigricans* en dos arrozales de los Llanos Occidentales de Venezuela" (winner of prize for best poster); and oral presentation entitled "Actividad de murciélagos insectívoros aéreos en arrozales de los Llanos occidentales de Venezuela"

We will continue participating in congresses to present the results. Also, we will prepare manuscripts for publication in scientific journals. Finally, as it was indicated above, after the study finish, we plan to conduct workshops directed to rice producers in the Western Llanos states of Venezuela, to communicate the potentiality of insect-feeding bats as biocontrollers of rice pests. We will show the most relevant results of our study for that purpose.

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

The RSG funds were delivered in October 2012; however, these funds started to be used in late October 2013, when the project formally began (see reasons above). It was difficult to predict delays that occurred at the beginning of the project. But I am sure that, despite of these delays, this project is going to produce very positive results, useful to promote conservation of insect-feeding bats associated with rice crops in the Venezuelan Llanos, and to help rice growers to reduce costs in chemical pest controls.

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
2 bat mist nets Avinet 2.6 x 6.0 m	116	142	-26	
2 bat mist nets Avinet 2.6 x 12 m	154	177	-23	
1 canopy mist net Avinet 2.6 x 12m	96	0	96	
6 bat mist nets Avinet 3 x12 m	0	300	-300	
50 bat bags Avinet	161	161	0	
1 digital caliper	141	0	141	
1 100 g balance	51	0	51	
3 Field books	15	15	0	
2 Ultrasound Detector Echo meter EM3+	0	1412,8	-1412,8	Because the ultrasound detector Echo meter EM3+ have a sampling rate higher than the ultrasound detector Pettersson D240x, we decided to buy two for the project.
1 Software SonoBat, version 2.9.5	205	986,4	-781,4	We made the decision to buy a software with greater capacity for analysis (SonoBat 3.1)
Identification and quantification of pesticides	3552	0	3552	The objective "To identify and to quantify pesticide residues in insects and insectivorous bats

				associated with rice and corn fields" was eliminated.
Reagents and disposables to identifying insect pests based on DNA barcoding	673	800	-127	
DNA isolation, amplification and sequencing	0	1200	-1200	Because the study period was extended, a larger number of samples were collected, and consequently the cost of the dietary analysis increased.
Gasoline	194	194	0	
Vehicle maintenance	642	611.8	30,2	
Total	6000	6000	0	

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

It is important that researchers who are studying the same subject in other parts of Latin America exchange their experiences to formulate unified strategies for the conservation and management of insectivorous bats associated with agricultural crops in tropical areas.

We need to generate a solid and permanent alliance with crop producers in tropical Latin America, selling them the idea of using bats as biocontrollers, and therefore, helping to promote bat conservation in the regions where crop lands are more important in each country.

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?

Throughout our work, we have always recognised the financial contribution of RSFG.

11. Any other comments?

We are grateful to RSGF, BCI, IdeaWild, IVIC (Instituto Venezolano de Investigaciones Científicas) and UNA (Universidad Nacional de Costa Rica) for supporting us in this project. We also regret not having met the set time, but this was a situation that is beyond our control. However, we are committed to complete this project as it surely will give great contributions to the conservation of bats. I commit to continue sending to RSFG my advances and achievement during the rest of the project.

Appendix 1.

Relative activity of various species of bats throughout the life cycle of rice (data obtained during exploratory study).

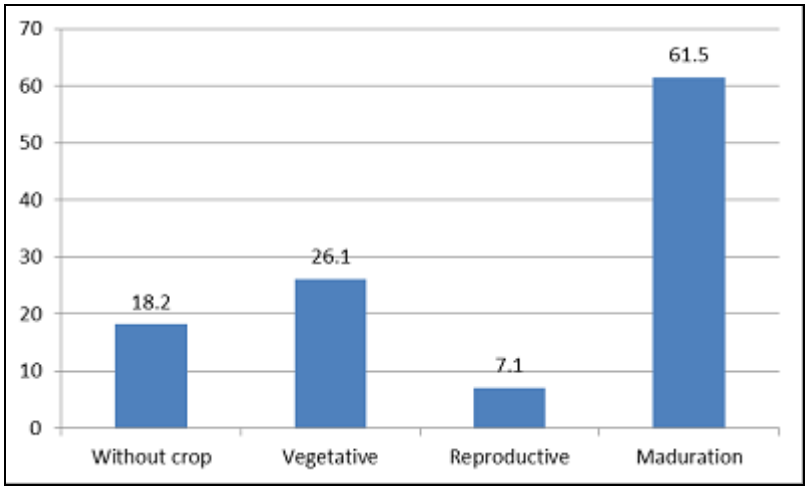

Figure 1. Relative activity (%) of *Molossus* through a life cycle of a paddy field located in Turen, edo. Portuguesa, Venezuela.

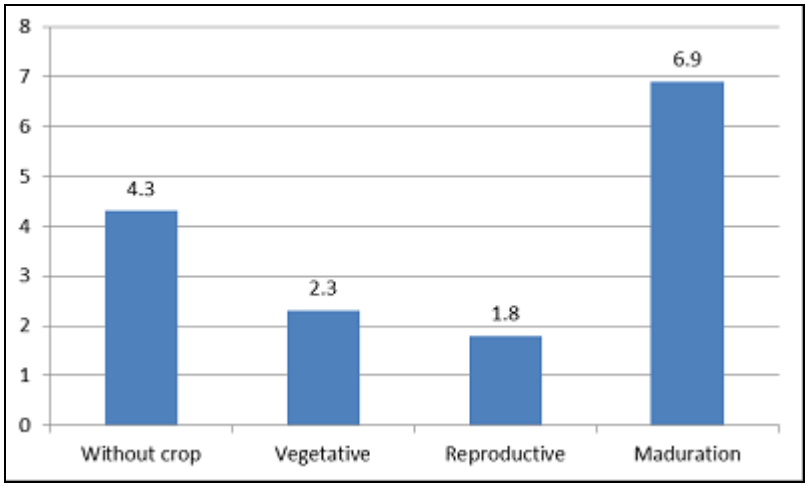

Figure 2. Relative activity (%) of *Myotis nigricans* through a life cycle of a paddy field located in Acarigua, edo. Portuguesa, Venezuela.

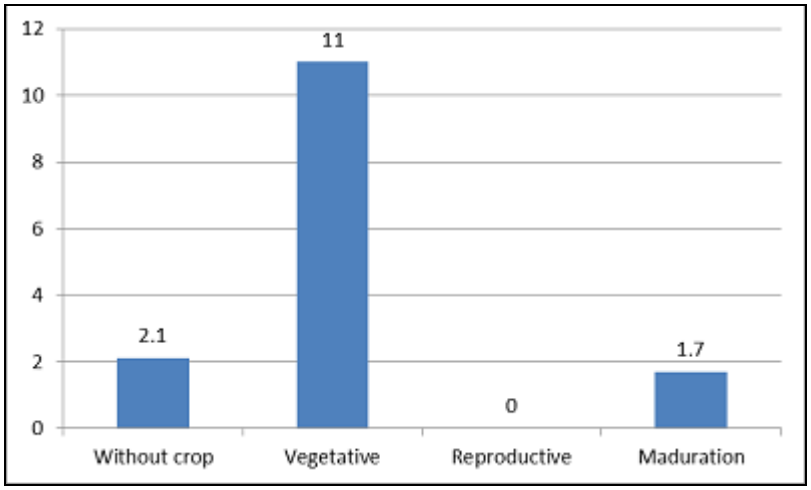

Figure 3. Relative activity (%) of *Saccopteryx bilineata* through a life cycle of a paddy field located in Acarigua, edo. Portuguesa, Venezuela.

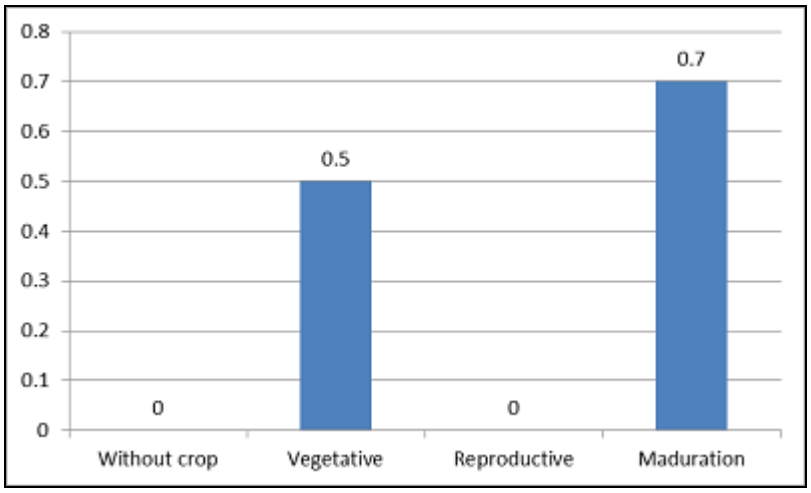

Figure 4. Relative activity (%) of *Pteronotus davyi* through a life cycle of a paddy field located in Turén, edo. Portuguesa, Venezuela.