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	Marcia Carolina Munoz
Project title	Climate change and consequences for plant-frugivore networks in tropical Andean forest
RSG reference	11042-1
Reporting period	Last report
Amount of grant	£5736
Your email address	marcarmu@gmail.com
Date of this report	27th September 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
1. To analyse the network structure		**x**		According to the data, I found 81 frugivorous animals and 52 plant species, and more than 1395 interactions in the Andean forest. But I am still learning how to use and interpret the network metrics to generate accurate data with relevant information for my study area and the species involved in the interactions. As these analyses are part of my PhD project I will continue working on this data to be able to publish these results.
2. To recognise animals and plants that are key species in the Andes		x		I have been working in the network analysis and understanding the meaning of these indexes in order to identify the most important species for the forest. So far, there is a potential list of the "key" species (five plant species and five bird species). But after finishing with the network metrics I will be able to give the name of these species with confidence and the respective index to support my statement.
3. To identify the link between network functioning and seedling recruitment		x		During the sampling we gathered information for 3057 seedlings dispersed by frugivorous animals in my plots, which is the key information to achieve this objective. However, I still need to associate the specialisation level of the frugivorous bird with seedling recruitment, information that I will obtain after completing the network analyses.
4. To share information with local people and staff from the Natural Parks			x	Two talks were given to the personnel of the protected area. In total, nine persons attended to the talk, including the manager, two biologists and six park rangers. One workshop to the children from

				the local school (nine children, the teacher and one person from the national park in charge of the environmental programme of this protected area). One workshop with the local group "Soledad de Montaña" and local guides. In total 15 persons attended the activity. Two posters where printed and are currently visible for visitors of both parks, the national park (SFFOQ) and the regional park (Ucumarí).

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

The main difficult of the project was to measure all the variables in the field in only 1 year. Due to the topography of the study area (mountainous), the distance between places and the amount of variables involved in this project, I had to organise and additional fieldwork, five instead of four to complete all the variables in the field. Likewise, I carried out only two seedling surveys instead of four, because the identification process and the fieldwork itself were extremely time consuming. Three biologist were working together to be able to finish with the seedling survey.

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

The main result is a complete and unique dataset with information of the frugivorous animals involved in mutualistic interactions with fleshy fruit-plants from the cloud forest in the Andes Forest, one of the most biodiverse spots on the world. This project gathered information for 81 frugivorous animals, 78 species of birds and three diurnal mammals. There is a large group of birds consuming fruits; the most representative's large bodied frugivorous birds were the guans (Cracidade, with four species), toucans (Ramphastidae, four species) and cotingas (Cotingidae, six species). Another important typical group were the small bodied frugivorous birds, with the family Thraupidae (13 species). The only diurnal mammals eating fruits were three species, the red-howler monkey (*Alouatta seniculus*) and two squirrels (*Sciurus pucheranii* and *Microsciurus alfari*). All these frugivorous focused their consumption on 52 fleshy fruit plant species and had 1395 interactions among them.

Another important result of this project is the identification of the most important plants and food resource for the whole frugivorous community in the study area. For doing this, I estimated the *strength* value for each plant species, which is a measure of the importance for frugivorous animals in terms of providing food for most of the frugivores in the network. A high *strength* value may indicate that the plant could be playing a role as a "key species" in the cloud forest. The species with the higher *strength* value were: *Alchornea grandiflora* (Euphorbiaceae, with the highest value of the metric *strength*: 15.9), then followed by *Cecropia telealba* (Urticaceae, *strength*: 7.7), *Miconia* sp. (Melastomataceae, *strength*: 6.7), *Oreopanax caricifolium* (Araliaceae, *strength*: 5.0) and *Miconia acuminifera* (Melastomataceae, *strength*: 4.9). The metric strength was estimated for every species involved in the network using the Package bipartite in R program (Package bipartite).

One notorious preliminary result of this study is the list of the frugivores that have a strong relationship with some plants, and are the main fruit eaters for some plants species in the network and potentially "key" species in terms of fruit removal; hence these birds may be playing an important role as a seed disperses also. These frugivorous birds were: *Aulacorhynchus prasinus* (Ramphastidae, *strength*: 4.3), *Anisognathus somptuosus* (Thraupidae, *strength*: 4.1), *Pyroderus scutatus* (Cotingidae, *strength*: 3.7), *Buthraupis montana* (Thraupidae, *strength*: 3.2) and *Chlorospingus ophthalmicus* (Thraupidae, *strength*: 2.9). However, I cannot be sure that these species are the main seed dispersers of the forest, because there are other aspects of the seed dispersal process that were not measured in this study such as gut treatment and effect on seed germination. Nevertheless, the metric *strength* suggests that these five bird species are very important due to their high frequency of visit to some plants species; therefore they are valuable from the perspective of the plant community.

Finally, the effective seed dispersal was estimated through counting the number of seedlings (only fleshy-fruit plant species) in 600 plots (1 m^2). In the first survey, there were 2040 individuals belonging to 257 species that were dispersed by frugivorous animals. After 1 year, 580 seedlings died, but there were 1017 new individuals in the plots. Although so far there is not a significant correlation (P = 0.4047) between the number of seedlings and the number of interactions between the plants involved in the network, I must explore this relationship having into account the specialization level of this interactions to understand better these results.

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

There were two types of benefits; one direct and I called this "awareness" about two topics, climate change and the link seed dispersal-forest regeneration. The second is an indirect benefit, an additional economic income. Unfortunately, the topic of climate change is a relevant issue for the academic community or people working in conservation fields but not for general public and less for local settlers. Most of the people who were participating in my workshops were able to integrate the relevance to these topics for their daily life and the forest around them. Likewise, the local guides were very grateful with this information because they got a new tool to give better talks to the visitors of both protected areas. The indirect benefit was the money that this project left to the local organizations in charge of the ecotourism in the study area for the payments of food and accommodation. In the last three years some local association (e.g. FECOMAR, Yarumo Blanco) have been implementing the "ecotourism" in the protected areas of Risaralda (study area State). However, this type of tourism works well in the high season, especially in the period June-August and January. But, the rest of the year these places have few visitors, therefore this project helped to generate some additional incomes during the low tourist season.

5. Are there any plans to continue this work?

Yes, there are several ideas to continue with the understanding of the animal-plant interactions in the cloud forest, and the potential impacts of climate change on the forest regeneration. One idea is to work with the nocturnal mammals, in this case with bats, to complete the whole picture adding all the fruit eaters in the forest. Hopefully, next year I will start looking for economic founding to carry out this project. The second idea is to work with seed germination of the main "key" plant species of this study area. One of the field assistants of this project (a botanist) is planning to work with seed

germination success in different type of habitats. We already applied for funds and are waiting the answer. If we get the grant, this project will start in 2014. The next step is estimate population densities of some of these "key" frugivorous birds to understand better their contribution to the seed removal and estimate better the amount and quality of their seed dispersal. Finally, I would like to assess in more detail the quality of seed dispersal of some frugivorous birds in the Andes forest. I am trying to start this project with a master student, although it is not sure. The last idea is to do a long-term study of seedling recruitment and continue with an annual survey of the seedlings that were already surveyed and labelled during this project. To do this, I will get the support from a professor and her research group at the Universidad del Valle (Cali, Colombia).

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

I'm planning to attend and give a talk at the 51st annual meeting of the association for tropical biology and conservation (20-24 July, Australia). Another interesting conference to show my results is this annual Conference of the Society for Tropical Ecology, focusing on Tropical Ecosystem-Between Protection and Production, the next February 2014 in Germany. I would like also give a talk in the 5th Young Scientist Meeting" at Senckenberg Natural History Museum and share my results with my colleagues from the Museum in which I am working with. Additionally, I will start to submit the first publications of this work the next year, and at least to publish three papers in peer-reviewed ecological journals.

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 economic support from the grant was used to finance the field-work along one year. The whole project has three periods, first the fieldwork, the second part is the data analysis and the third and last part is the writing of the final papers. In my case the grant was fundamental to be able to collect the data in the study area, and now I can move forward with the following steps of this research 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
Personal	1400	1400	0	
Fieldwork	3984	4050	66	Although I did five fieldwork visits, I got some additional discounts such as accommodation as food from the national park system and CARDER (environmental authorities at national and state level, in charge of my study area)
	616	286	330	The director of the SFFOQ (Santuario de Flora y Fauna Otun Quimbaya) facilitated everything to do the workshops, then I did not have to pay for the conference room or the projector. I also got a discount for the snacks and food to the workshops.
Total	**5384**	**5450**	**5736**	

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

The main following steps with this project are: 1. to analyse and get the full set of results, 2. to publish and attend some conferences to communicate my results and 3. to continue with other research projects with this system to understand better the consequences of global warming in this rich ecosystems.

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?

Yes I did, I used the logo for each talk or workshop during the project, and I will use this logo for the next international conferences that I will attend. The posters that are already in both protected areas, the national and the regional park, include the Rufford logo.

11. Any other comments?

Rufford Foundation made an important economic contribution to the execution of my project, but I must highlight that thanks to Rufford grant I had the opportunity to teach and talk with a non-academic public, the local people. Each workshop was a challenge to me, but it was worthwhile the effort. My public was very receptive and participative during all the seasons and workshops. In certain way, the Rufford grant opened a new opportunity to communicate and interact with the local people.