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	Sara Lucía Colmenares Trejos
Project title	Functional trait approaches to understand ecological processes of palm species along an altitudinal variation gradient in threatened Brazilian Atlantic Forest.
RSG reference	18653-1
Reporting period	January 2016 To January 2017
Amount of grant	£4914
Your email address	quehubosara@gmail.com – slcolmenarest@gmail.com
Date of this report	31 03 2017

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
The aim of my work is study how palms are responding to an altitudinal variation gradient to identify factors driving community functional distribution and shifts.			X	
Measurement of species relative abundance for adult and juveniles		X		Even when I measured the whole species that compose the palm community, rare species remained under-represented for some of the functional analyses. Weather conditions associated with heavy rains and logistical issues with hosting (pest invasion) were the major problems to achieve this goal.
Traits measurements of young and adult individuals.		X		To achieve our main goals, we realised we had to increase our sampling effort in terms of area to find more individuals, time and collaborators. Main issues against this goal were: Delay during the first 3 months due to the heavy rains. Delays because of personal and academic travels. Intense laboratory work that demanded too much time. Lack of funding to determine traits like isotopic signature of C and N. However, we collected the samples and they are stored for measurements when possible. Stomatal density is still incomplete due to laboratory availability issues. The samples are properly stored to do that when possible.

Measurement of Environmental conditions at each area.				Soil and air humidity were not possible to be recorded periodically because of technical issues with the devices installed at field in some areas. Light availability was not possible to be measured because of the rain.
Proposing guides for conservation and management that prioritize palm species preservation.				Some of the species have niche restricted distributions along the whole elevation gradient, as well as some dispersal limitations and dependence on shady environments. The necessity of maintain, expand or connect wide forest regions to diminish species confinement may help this species to improve their population stability. We need to develop better divulgation to these results.
Finding the trait – environment responses along altitudinal variation and its influence in palm species distribution and community assembly.				We found that species functional responses are tightly correlated with environmental conditions, especially soil characteristics, and environmental changes driven by topography.
Identification of key traits in response to environmental variation, (an aim as well as an issue in this work)				We found that traits responded differently to environmental conditions, making it difficult to find any key trait in response to environment. However, light response and dispersal traits were the principal descriptors of functional community structure.
Find the relevant factors that can explain the variation in palm distribution along the altitudinal gradient.				A strong species-environment interaction explained palm distribution along elevation. However, we found that there are other factors involved in species distribution like biotic interactions and dispersal limitations.

Identify the species that can be prone to extinction, or variation in distribution ranges and habitat.				We identified that understory species appeared to be the more vulnerable to environmental changes, due to their tight relationship with specific environmental conditions, because of their narrow distributions, some of them confined to very specific areas, and with low trait plasticity. These species are: *Attalea dubia* (Mart.) Burret, *Bactris caryotifolia* Mart., *Bactris vulgaris* Barb. Rodr. *Lytocaryum weddellianum* (H. Wendl.) Toledo, *Geonoma elegans* Mart., *Geonoma pohliana* subsp. *kuhlmannii* (Burret) A.J. Hend., *Geonoma pohliana* subsp. *trinervis* (Drude & H.Wendl.) A.J. Hend., and *Geonoma pohliana* subsp. *wittigiana* (Glaz. ex Drude) A.J. Hend.
Are Palms responses good indicators of the forest health?				We found that understory functional group is a good indicator of the quality of the forest.

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

Weather was the main difficulty to collect the data set for the project. Rain and thunderstorms are strong and dangerous in the area. Once, I got trapped at field because of a severe flood. My crew and I had to walk more than 15 km in the rain to get back to the lodging, compromising our health and our devices. For this reason, I saw myself compelled to wait patiently whenever it rained to do not put at risk my integrity, the field assistant's integrity, as well as the devices (which are expensive apparatus for plant physiological measurements).

This provoked a considerable delay and slowing down on my field collection and the entire project schedule. I ended focusing in the richest palm area, leaving re-samplings of some areas left aside due to lack of time.

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

Palm assemblage is strongly influenced by species–environment relationships associated with local soil conditions and topography, especially for range restricted species.

Functional analyses showed that at interspecific level species can be differentiated by the posse of different traits, indicating they occupy different environmental niches. By other side, intraspecific trait variation appeared higher in juveniles than in adults, but not the phenotypic integration. However, there are shifts in trait relationships and changes in the relative importance of community assembly mechanisms during ontogeny. Importantly, understorey species appeared to be the more vulnerable to environmental changes, due to their tight relationship with shadow, soil and topography, and because of their narrow distributions. Species distribution is being mediated by sets of functional traits, where species more tolerant to light and with wide dispersal capacity and niche germination can be more efficient in response to environmental constraints than species from shadow environments and small niche distribution, which makes them vulnerable to drastic loses if natural habitat is depleted, exploited, or destroyed.

Accumulation of species at intermediate areas, in the Atlantic Forests, has been recognised as a shrinking effect on species range distribution in response to losses in forest coverage and human exploitation. We consider that increase and connect conserved areas, more than prioritise only the richest places, should be the key for the maintenance of these palm populations.

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

This work has been important for palms recognition. Many interviews with local people, demonstrated the complete ignorance about the palm species unless it were of economic interest (*Euterpe edulis*, *Lythocaryum weddelianum*) or common in fragmented areas (*Astrocaryum acculeatissimum*). With the study, all the institutions, and specially forest rangers and owners of the reserve and park directors know the whole set of palm species present at their areas. Ranger and owners from REGUA, which is the area with the most palm species richness, learned to localise and identify the species at field by scientific name. They said that during 50 years by living and working in the area they never noticed the diversity of palms, and expressed his surprise with the huge variation among them, and the specificity of the places where some of them occur.

We made a short video at the forest talking about the importance of the palms to the forest. The video was made in Portuguese to be divulged among the local community, especially to children. We presented the video to children that participate in the Program "Young Ranger" at REGUA.

Results has been presented at scientific meetings like ATBC 2016 and PARNASO Scientific Meeting 2016 with preliminary results. The work was presented too at the First Rufford Latin- American Conference held in Recife, PE, BR, in January of 2017.

Some of the results had been used by me for scientific courses about functional diversity in countries like Colombia.

5. Are there any plans to continue this work?

Yes. This work is part of biggest Project which has parallel works happening, focused on some individual species (e.g. *E. edulis, L. wedellianum, A. acculeatissimum*). The plots and the palms that I labelled at field will be continued monitored for population studies and for functional variability that includes variation in time, following different seasons. So, my project ended as doctoral research, but it will be continued as a main laboratory project, through other master, doctoral or postdoctoral works.

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

We are working hard on paper submission of our results on international journals. At the same time, we participate of national and international meetings to show the results.

We were planning to elaborate informational posters for the parks.

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

It began to be used since February 2016 and it was in use for some last and rapid field visits until November 2016. Our schedule was not accounting with the logistic problems we had.

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
Diary meals for researchers (180 days)	1465,80	1441,37	24,43	Food covered usually for me and 1 or 2 field assistants.
Transportation 1, (about 2 times per month) Rio de janeiro-Teresopolis-	106,77		106,77	Field collection and samples were collected with the help of a trained assistant. Weather conditions and subsequent delays made not possible to repeat measurements at this area.
Transportation 2, (about 2 times per month) Rio de	456,03	1131,02	-674,99	We had to focus all our work on this area. The difference in the amount of money is

janeiro-REGUA-Rio de janeiro (Bus + Local)				because we had to rent a specific transport service, since it was too much difficult to carry all the field material in public transportation, and due to the difficulty to reach the research area (no telephone signal, no easy roads).
Transportation 3, (about 2 times per month) Rio de janeiro-Cachoerias de Macacu-Rio de janeiro (Bus + Local).	278,68		278,68	Weather conditions and subsequent delays made not possible to repeat measurements at this area.
Field work assistant trained in tree pruner device use for palm leaves and fruits sampling. R$100 x 1 day x 4 days per month x 6 months	434,31	434,31	0,00	
Field guide and general assistance fees. R$100 x 1 day x 180 days (REGUA and Tres Picos State Park)	2171,55	1000,73	1170,83	We had to include to these expenses Brazilian bank and money exchange taxes, as well as unexpected budget that including field material, and some extra transportation expenses.
TOTAL	4913,14	4007,42	905,72	

Notes to Budget box: 1 GBP = 5, 5260 BRL Last Updated: 8/31/2015 7:51:30 AM http://themoneyconverter.com/GBP/BRL.aspx

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

The important next steps include sampling of species material for molecular sequencing which make possible to analyse species phylogenetic structure and trait conservatism, and track this species along the evolutionary history of the family.

The expansion of the study area to other regions at Serra do Mar and Atlantic Forest to understand biogeographic and phylogeographic distribution, as well as to confirm the patterns observed for the studied scale. It is important to conservation to recognize potential connectivity areas.

Explore the effect of biotic interaction as predation, animal dispersion and soil microbiota associations with palms, as well as phenological differences among species and its relation with seasonality.

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?

Yes. It was used for scientific meetings and it will be used for publications. I posted on my website and on Twitter.

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

12. Any other comments?

I like to thank to the Rufford Foundation for its financial support. It was crucial for the development of our work.