

Final Evaluation Report

Your Details	
Full Name	Luis Carlos Beltran Lacouture
Project Title	Tropical Forest Restoration: Evaluating the Return of Biodiversity, Forest Structure, and Ecosystem Processes to a Fragmented Tropical Landscape
Application ID	27870-1
Grant Amount	£5000
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1. 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
Study I: Determine the mechanism by which an invasive fern species (<i>Nephrolepis brownii</i>) interferes with restoration at our plots.				The experiment was successfully established but I have been unable to harvest the plants I germinated due to the COVID-19 crisis. As soon as the trip is permissible and safe, I will travel to Los Tuxtlas to harvest the plants.
Study II: Determine how soil quality (e.g. carbon content) differs by treatment and has changed through time.				The soil samples have not had their isotopic content analysed because by the time we got them to Chicago, the COVID-19 crisis prevented us from going to the lab to analyse. As soon it is safe for our team to work in the university, we will resume with the analysis.
Study III: Determine if granivore animals preferably forage by restoration treatment				We successfully carried out the foraging experiment. We found several rodent species forage for seeds in the experimental restoration plots. These were photographed with camera traps. A manuscript on this study is forthcoming.
Study IV: Evaluate restoration success using a rapid ground assessment of the plots' structural complexity				While a rapid ground assessment of the plots structural complexity was carried out, with extra time and resources we decided to make it more detailed by recording the identity and diameter of every tree taller than 2 m. This has evolved into a much more detailed study on the return of biodiversity and development of forest structure. A manuscript is in development.

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

Study 1

- Concerns arose about how to bury the PVC pipes into the ground of the restoration plots. The concern was, if we dig out soil with a hand shovel, fill the pipe with the soil, reinsert it with the seed, the soil structure will have shifted due to our actions. We decided to invest in a hole digging-device that

allowed us to extract the soil, place it in the pipe, with minimal effect on the soil structure.

- Our hole digging-device was stolen by unknown party. Friendly neighbours lent us theirs so we could resume.
- Tracking seeds that were not germinated in PVC pipes was a concern. We addressed this by creating PVC rings (2 x 10cm) that we placed around them. We also created wooden stakes with metal tags to keep track of every germinating seed.

Study 2

- Part of the reason we wanted to do this soil nutrient study was to compare with values from 2006. However, after drafting this grant one of our collaborators pointed out that the soil nutrient content varies greatly in response to the rainy season, so a proper time-based comparison must be carried out in the same month as the 2006 study. They collected the soil in October, so I redrafted my plans so I could return to Mexico briefly in October as well to collect the samples.
- Importing soil for the isotope analysis from Mexico to the United States requires a permit from the USDA. I successfully obtained this permit.

Study 3

- Our foraging trays used sand as a medium for the foragers to dig through in search of food. While we started this study in the dry season, we were caught by rain more than twice, which forced us to replenish the sand. This was a laborious task, but one I tackled by hiring extra help in the local area to replenish the sand whenever needed.

Study 4

- Identifying trees in the tropics is always difficult but I tackled this problem by talking to local people as often as possible to determine which common names corresponded to which scientific names. This allowed us to identify 99% of our 7,210 trees.

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

1. From Study 4 we learned that the differences in biodiversity and structure between the plantings and the unplanted control are not as significant as the differences between these treatments and the forest. While it is not surprising for the plantings to not yet resemble the forest, the lack of differences in recruitment between planting treatments suggests that selecting solely animal-dispersed species to create plantings does not significantly influence the recruiting plant community. In fact, the great degree to which the plots share biodiversity is indicative of how dispersal agents use our experiment as a stepping-stone biological corridor. They may be attracted first by the fruits, but they then fly to other plots dispersing additional seeds. Further analysis is ongoing and necessary, but this seems to suggest that in selecting species for plantings it is not as important for all the species to be animal-dispersed species. It is likely that an assemblage that can swiftly create multiple layers of canopy and early fruit production within the first couple of years will be most effective.

2. From Study 2 we learned that both carbon and nitrogen are lower in the treatment plots than in the surrounding pasture. We only expected nitrogen to be lower (fencing prevents cattle from depositing faeces). The lower carbon might be a result of this developing forest taking more resources than it is giving. Once we conduct the isotope analysis, we will be able to determine if this is indeed the case or if it can be expected for the system to soon become nutrient-deficient.

3. From Study 3 we learned that the Los Tuxtlas cotton rat (*Sigmodon toltecus*) has reappeared in the experiment. My advisor had previously published a study on this species' appearance and disappearance from the experiment. Its resurgence might be explained by the fern cover of the experiment that provides terrestrial animals with cover from predators. The camera traps also revealed that armadillos are common in the plots, which has inspired us to plan a second foraging experiment focused on them.

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

My field assistants and their families directly benefited from the project from the income I provided them with. My main assistant, Dario Velasco, lives in a town with virtually no employment opportunities. Work with me allowed him to obtain sufficient funds to get necessary medical treatment and fix the roof of his house. We have also developed a strong friendship through our passion for tree identification, which has allowed me to more directly access other community members and talk about their perspective on nature, reforestation, resource use, and more. This is tremendously important here, as some Los Tuxtlas residents are apprehensive of foreign researchers or reforestation in general. If Los Tuxtlas eventually becomes a hub for reforestation, it will be because of researchers like us that seek to make these things happen through collaboration and friendship with the local community.

5. Are there any plans to continue this work?

Yes! The projects have not finished due to the COVID-19 crisis forcing us all into hiatus. The projects will eventually be completed. An additional foraging experiment is also being planned, inspired by the data we collected thanks to this Rufford grant.

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

Every single one of these studies will become its own publication. I have also presented some of this data already at seminars at my university (UIC). Upon my return to Los Tuxtlas, I plan on talking to the field station manager about finding ways to best communicate the information to local stakeholders.

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

Funds were used during the anticipated length of the projects (mid-May 2019 to late-August 2019). I continued to pay my field assistant, Dario Velasco, for a weekly

check-up of the germinated seeds up until October 2019. Beyond October, I continued paying Dario using external funds. I did return to Los Tuxtlas in mid-October as well to carry out the soil study that originally was planned for earlier in the summer, but external funds were used to pay for the travel. Rufford Funds were used for lodging during the October trip (5 days).

8. Budget: 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. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Viper Antivenom	375	97	-278	
Transport	624	1323	+699	The original plan was to purchase a quadbike (ATV). However, due to logistical problems, I concluded along with my colleagues that it was best for me to rent one instead. I rented an ATV for 300 pesos per day. When the ATV broke down, I switched to a small motorcycle, for 200 pesos per day.
Lodging at Los Tuxtlas Biological Station	1373	1356	-17	I stayed for 84 days. I returned in October for five days with two other field assistants/collaborators from UNAM as part of the soil study.
Flight to Mexico	427	207	-8	These are only flights for the planned summer field season. I did not use the Rufford Funds for the flights of the October trip since that was not in the original plan.
Flight from Mexico		212		
Soil Physicochemical Analysis	560		+560	The cost of this analysis is the cost of the chemicals required to do the nutrient extractions.
Camera Traps	432	330	-103	
Main Experiment Maintenance	483	330	-153	
Field Assistant	726	1006	+280	
Total	5000	4861	-139	Supplemented with external funds.

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

In terms of the studies produced through this Rufford grant, there is still additional sample processing, data analysis, and dissemination to do. Past these studies, the main restoration experiment is still developing and will continue to provide us with key information on restoration processes. Repeating these experiments years from now will shed light on how ecological succession of tropical forests occurs in tree islands across fragmented landscapes. This information will help inform stakeholders interested in community development strategies that meet local economic needs and conservation goals.

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

Yes, at my University (UIC) I have given two presentations on the studies completed thanks to the Rufford Grant. I verbally acknowledged the Rufford Foundation and included the logo in the acknowledgments slide.

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

Dr. Henry F. Howe (UIC) is my PI. He was crucial to developing the studies and provided guidance throughout the run.

Dr. Cristina Martinez-Garza (UAEM) is a member of my PhD committee. She also started the restoration experiment, so I consulted with her often to make sure that my studies did not interfere with the main restoration experiment. She is a co-author on the manuscript we are drafting from the data of Study IV.

Dr. Miquel Gonzalez-Meler (UIC) helped me draft the soil import permit. He will carry out the stable isotope analysis without cost. He is a co-author on a manuscript focused on presenting the conclusions of Study II.

Dr. Julio Campo (UNAM) was crucial to collecting and processing soil from the restoration experiment. He helped connect me with resources at UNAM and together as a team we left for Los Tuxtlas to collect the soil. He too is a co-author on the manuscript for Study II.

Dr. Karla Aguilar-Dorantes (UAEM) is my collaborator in the fern interference study. She helped me improve the experimental design and obtain the necessary materials. She is a co-author on a forthcoming manuscript from Study I.

Dario Velasco was my main field assistant. He helped me establish the experiments, monitor them, and was crucial to identifying tree species.

12. Any other comments?

Thanks to the Rufford Foundation I had my most productive field season yet. I am now on route to finishing my PhD within the next year and I am excited for all the manuscripts that will come out of this work. The next step for me will be to return to Colombia to establish my own restoration experiments and projects. I look forward to working with the Rufford Foundation to accomplish those goals too.