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	Johan David Reyes
Project title	Distribution pattern of ferns and lycophytes along the altitudinal gradient in the Celaque Mountain National Park, Honduras
RSG reference	23585-1
Reporting period	18/07/2018 – 30/07/2019
Amount of grant	£4,765
Your email address	botanicareyes@gmail.com
Date of this report	31/07/2019

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
To determinate the distribution pattern of ferns along the altitudinal gradient in the Celaque Mountain National Park (PNMC), Honduras				Even though data has more dispersion than expected, it adequate to current models of mid-elevation diversity patterns observed in México and Costa Rica on ferns. Climate variables help explain it, although not perfectly (other variables were not considered, and their contributions remain unknown).
To evaluate richness of the fern group of the PNMC and an update of its diversity				With over 162 collected species (pending ID around 30) we can confidently mention that the richness of this groups are still not fully evaluated in the PNMC, specially considering 34 new records for the park (out of 215 spp. already reported) and with room to add more after more ID of this records, three are new for the country.
To establish a water monitoring measure and detailed climate data of the PNMC				Due to the PNMC dimensions, gradient and relative short staff, the intention of setting a water monitoring programme with pluviometers was far from achievable. Arduino based humidity and temperature sensors were also a problem to maintain as cold weather drained the batteries in under a week and expeditions to change them on long term would require a semi-permanent staff member. Two arduinos will remain at lower elevations were data collection is manageable by park rangers.
Establishments of priority conservation areas for the management of species based on optimal climatic zones.				Data shows that there are two levels of richness involved on the PNMC that are of interest for conservation management. In-plot richness follows an upward increase, showing that the upper altitudinal fringes (2,500-2,800 m) are species rich reservoirs for epiphytes and small ferns (mostly with limited altitudinal ranges). On a fringe level richness, the pattern stablishes areas

				around 2,000-2,200 m to be the most diverse (so far without the pending IDs) which shows the need to preserve this areas (such as the "El Gallo" trail which is mainly reserve for research and revealed a considerable increase in richness compared to the main trails).
Study of the impact of climate change on sensitive species				Even though our data is still lacking long-term evaluations of climate variables. The data collected stablishes a baseline for future studies (specially the RH proxies using Karger et al., (2011) and in-plot data).
Study the Population of each species found in the plots (Including the endemic species of the park).				Although 162 spp. of ferns where collected, there are species which presence are not enough for estimating population data. Having mentioned this, most species, like the endemic *Ctenitis leonii* (Rojas), do have enough data to assess its populations, altitudinal range and conservation status. Some species of ferns can only be found in the PNMC and therefore can, in the future, be used to catalogue their conservation status (UICN) for Honduras
Book of ferns of PNMC.				Due to difficulty identifying in situ species, not all the collected species have a picture. Adding to this, not all the species registered for the park were collected. The proposal was changed form a book of ferns to banners and posters of rare species for the park. Identified pictures will be given to MAPANCE for their use.

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

The Celaque Mountain gradient is 700-2,849 m but the PNMC on the east side (selected for the study) officially begins at 1,200 m. Below that fringe, multiple communities had changed the use of the soil and therefore sampling of this area was not congruent with the intentions of the project. We had to reduce sampling plots to 85 by eliminating that part of the gradient.

We did not anticipate the possibility of inclinations that could prevent data collection. This became quickly evident specially at mid-elevations were data collection were harder than expected, due to this the 2,300 m fringe could not be evaluated and therefore only 80 total plots could be obtained. We solved this by

adding more days and assistants to these trips to be able to search for non-dangerous areas and work more carefully.

Mule rental was discouraged and even if used, some sampling places could not be reached through them. It was decided to have more assistants in certain trips and in some cases MAPANCE volunteers and personal friends helped carry equipment in exchange for covering their food and transportation expenses.

Around 30 fern specimens need to be identified before finishing the project to represent the new recorded fern diversity in the park. Researchers in the US have accepted reviewing the specimens and exportation permits are required to send them. In case this can not be achieved in time and form, this records will be excluded from final publication and assumed as morfo-species

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

A total of 4 publications will result of this research:

A.) A revision of a rare fern genus, titled "New records and notes on the genus Phanerophlebia (Dryopteridaceae) in Honduras" accepted and currently in editing in the Journal "Acta Botanica Mexicana

B.) A world-wide collaboration that represents the first use of Honduran ferns plot data, titled "Global fern and lycophyte richness explained: Determinants at two spatial scales" lead by PhD. Anna Weigand and under revision at "Journal of Biogeography".

C.) The first population study of an endemic fern in Honduras, titled "Estructura poblacional y características del hábitat del helecho endemico Ctenitis leonii" currently in development and expected in Honduran journal "Ceiba".

D.) The main publication and name of the project "Distribution pattern of ferns and lycophytes along the altitudinal gradient in the Celaque Mountain National Park, Honduras" that will be finished as soon as identifications of pending specimens are available and targeted for "American Fern Journal". We will add the new list of the park in this publication.

Knowledge of the distribution patterns from Central America and its role in the transition from subtropics to the tropics is poorly known and during the development of this study a paper in American Fern Journal" mentions that "additional data are needed to close the remaining gap of knowledge between Costa Rica and Mexico" (Hérnandez-Rojas et al., 2018). This project will contribute to this biogeographical knowledge gap.

Co-managers MAPANCE, as the main decision takers of the PNMC, will have access to the data base and more informed decisions for conservation management will be enabled due to this project.

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

Non-relevant.

5. Are there any plans to continue this work?

Yes, PNMC is clearly far from a completed fern checklist, as seen by this study, and considering that the east side of Celaque (selected for this study) is the best sampled area in Honduras (Piatek et al., 2012; Rojas-Alvarado, 2012; Rojas-Alvarado et al., 2018) and we are still able to find high amount of records just shows that other areas within the park might hide unrecorded fern diversity.

Besides the park, ecological data in the country is scarce and the question of how a complete altitudinal gradient (that starts from sea level) has still not been addressed. Population information on ferns is almost non-existent in Honduras and to assess conservation status (following IUCN) we would require more of this type of studies in other protected areas.

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

Scientific publications are the main way we can share the results but also giving MAPANCE the complete database, banners, posters and presentations are an extension of the outcomes of the project. There is a plan of developing a "Press Tour" after publications are officially published.

In addition, an interview for Diario Roatan (https://diarioroatan.com/parque-nacional-montana-de-celaque-una-joya-para-la-investigacion-cientifica/) and a presentation to the "Jovenes para la Conservación" (Youth for Conservation or JPC), a project of the Forest Service of the U.S.A, were developed in conjunction with Hermes Vega (MAPANCE).

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 RSG was used from July 18th 2018 to July 12th 2019. Some funds will be used afterwards for sending specimens to specialists in the US (Approved by Trust Administrators of the Rufford Foundation).

We expected the project to finish data collections in February 2019, this was considerably delayed due to multiple problems (which were notified to Rufford contacts) and identification process is expected to be completed in a further date according to Honduran exportation permits, as this was not properly anticipated.

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
Transportation	450	416	-34	One less trip than expected
Mule Rental	193		-193	It was not used
Researchers Salary	1776	1776		Salary was used to focus on long trips and EAP herbarium work
Local assistant salary	740	620	-120	Some of the assistants were additional MAPANCE volunteers or personal friends. Lowering the quantity spent
Computer	453	398	-55	Computer was bought during Black Friday, considerably reducing costs
Made Pluviometers	265		-265	After considerations with MAPANCE staff, this was deemed not achievable and money was used in other unforeseen equipment
Staff Food	888	676	-212	Instead of a daily stipend for individual food, equipment was bought that allowed us to cook efficiently in the woods, lowering food costs even with more people involved in the trips.
*6 Arduino humidity and temperature sensor		374	+374	Arduinos were used to compare ChelsaClimate data with local data. Even though not fully successful, It was approved to donate them to MAPANCE and other Institutions in behalf of Rufford Foundations (Approved by Trust Manager)
*Food and basic camping equipment		218	+218	To lower food costs and depend less on borrowed MAPANCE equipment, we bought a camping tent, pots, camping stove, 50m. measuring tape and small equipment.
*Bank taxation		219	+219	This was unexpected as the total USD amount should have been 6,338 and we received 6,051. This can be verified in the first emails to Trust Manager
*Samples exportation to U.S.A		68	+68	This was approved by Trust Managers and will be complemented with EAP local herbarium funds
Total	**4,765**	**4,765**		L to USD = 24.20, USD to GBP = 0.76. Items with * were unforeseen additional

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

It is important to finish the publications and correctly analyse the collected data, for these international researchers have been contacted that will be in the main publication. Making the data available through MAPANCE will be crucial for more endeavours with ferns in the PNMC.

More fern projects focused in assessing population data and its relations with biotic and abiotic factors are needed in Honduras to properly develop a conservation plan, as this are not usually considering and their ecological services are of high importance.

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?

Rufford logo has just been used in the JPC conference but will be used in banners, posters and the Arduinos given to MAPANCE, Uyuca Biological Reserve and Zamorano University.

In the four publications, The Rufford Foundation is mentioned for financing the project (even in the world-wide collaboration). During the following "press tour" we will mention the foundation as integral to the success of the project.

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

Name	Affiliation	Project Role
Michael Kessler	University of Zurich, Switzerland	Main Project Advisors
Eric van den Berghe	Zamorano University	
Hermes Vega	MAPANCE	He was in charge of coordinating MAPANCE logistics and was a valuable in-field advisor
Rina Diaz	Zamorano University	She is the Herbarium curator at EAP and helped organized and dry all PNMC collections
Yeshua Rodas	UPNFM	He designed the Arduinos Humidity and Temperature Sensors
Farlem España	UNAH	They assisted in field data collections, without their efforts, the project could not have been possible
Andrea Figueroa	MAPANCE intern	
Juan Rodriguez	MAPANCE volunteer	
Enrique Segura	Independent	
Ali Rubio	UNAH	
Lodwin Caballero	UNAH	
Nicole Sikafy	UNAH	
Ruth Sanchez	UNAH	

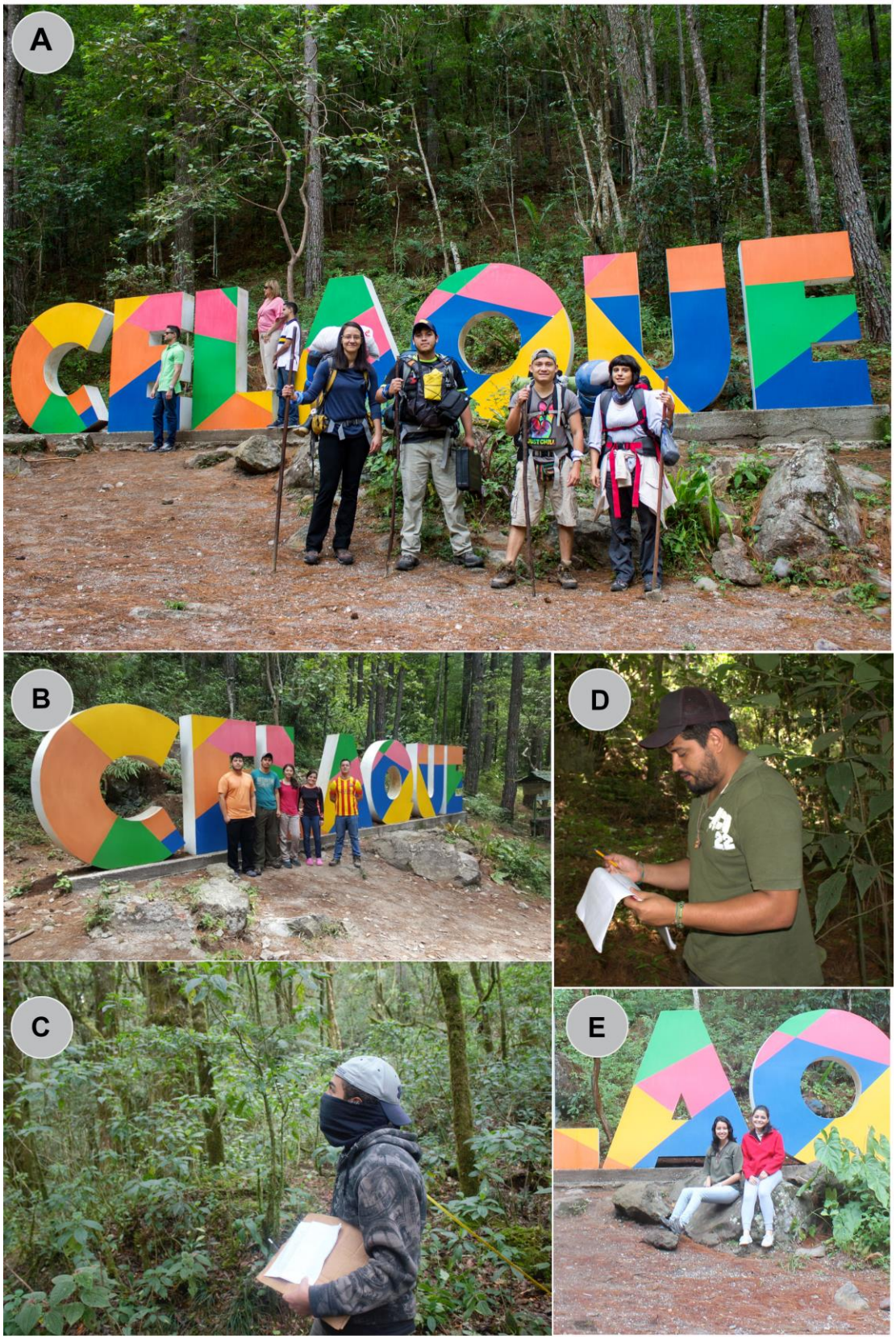
Jocelyn Castro	UNAH	
Cristopher Antunez	UNAH-VS	

12. Any other comments?

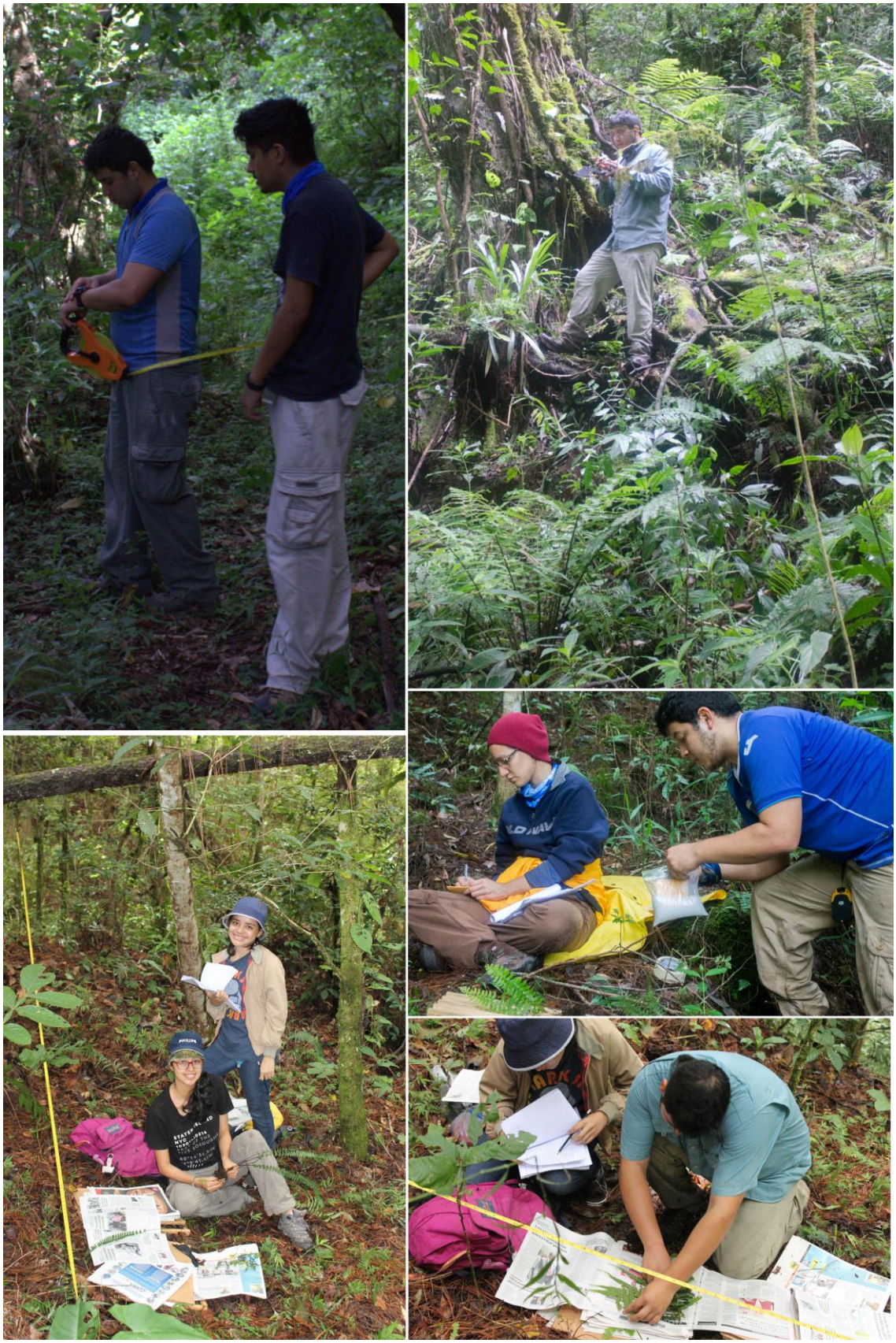
I would like to express my deep gratitude to The Rufford Foundation for their support. The RF has allowed me to do a passion project I have been dreaming for almost 4 years and given me the opportunity to lead my first project and to develop further into my career. This project is a first of its kind in Honduras and opens the door for more people to get involve in Fern conservation and research.

This project has been integral in my personal passion for research and my desire to study deeply Honduran fern diversity.

Project result presentation to MAPANCE and "Jovenes para el la Conservación"



Project assistants and volunteers. Left to right A. Ali Rubio, Johan Reyes, Juan Rodriguez and Nicole Sikafy; B. Johan Reyes, Farlem España, Jocelyn Castro, Ruth Sanchez and Hermes Vega; C. Enrique Segura; D. Lodwin Caballero; E. Andrea Figueroa, Ruth Sanchez



Data collection in 20x20 meter plots with assistants and volunteers.