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	Carlos Mauricio Delgado Martínez
Project title	Ecological role of small water deposits (sartenejas) to conserve tropical forest vertebrates in the Calakmul Region, México
RSG reference	24083-1
Reporting period	February 2019
Amount of grant	£5,000
Your email address	pistache06@ciencias.unam.mx
Date of this report	30th March 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
Introducing the project to local people				We introduced the project to the local authorities of "Centauros del Norte" community as originally planned; unfortunately, we couldn't conduct any other activity there because they warned us about the existence of a high risk of our equipment to be stolen. Thus, we decided to introduce the project to the people of the nearby community of "Nuevo Conhuas" where we found better conditions to conduct this study.
Locating sartenejas				We walked along 26 transects inside the Calakmul Biosphere Reserve (CBR) totalling 116.6 km of rainforest surveyed in the search of sartenejas. We succeeded in locating 18 sartenejas inside the CBR. Moreover, thanks to the information obtained from the application of semi-structured interviews to local people from "Nuevo Conhuas", we were able to locate 10 sartenejas more in communal lands.
Abiotic characterization of sartenejas				We found that sartenejas volume can vary from less than one litter to almost 2000 litters. Overall, we estimated a density of one sarteneja per 10 ha of forest. There was one sarteneja per 15 ha of forest growing on leptosol soils and one sarteneja per 7.5 ha of forest growing on phaeozem soil. We did not locate any sartenejas on gleysol, fluvisol and vertisol soils. By applying complete spatial randomness and Ripley's K tests, we found that sartenejas have a random distribution. We applied logistic regressions to assess if the presence of sartenejas

				was explained by variables such as vegetation and soil type, elevation and slope. However, none of these variables had explanatory power. The characteristics of water in sartenejas located inside the reserve and in communal lands were similar and no differences between seasons were detected. Water was slightly alkaline (pH =7.67 [SD ± 0.55]), highly saline (306.12 ppm [SD ± 223.30 (-19.66 mV [SD ± 26.86mV]) and with a high amount of total dissolved solids (359.64 ppm [SD ± 243.92 ppm]). These water characteristics are likely due to the predominant soil type (karstic) and the high quantity of vegetal matter occurring inside the sartenejas.
Biotic characterization of sartenejas				There were no statistical differences in canopy cover between sartenejas occurring inside the CBR and communal lands (range = 44 to 100%). The most common fruiting trees occurring around sartenejas were *Manilkara zapota*, *Brosimum alicastrum*, *Bursera simaruba* and *Guaiacum sanctum*. We are currently identifying main groups of protozoa occurring in the sartenejas
Monitoring water use by wildlife and water availability variation				We set up 20 camera traps in 10 sartenejas inside the CBR and 10 sartenejas in communal lands. Furthermore, we set up two data-logging rain gauges in the CBR and communal lands. We monitored water use by wildlife, rainfall and temperature over a year. We found that sartenejas can catch water with moderate precipitations (2.5 - 7.6 mm of water per hour). On the other hand, we recorded more than 30,000 camera trap videos, which allowed us to document use of sartenejas by 42 bird species, 24 in the CBR and 35 in communal lands. The most common bird species in the CBR was *Crax rubra* (a vulnerable species), whereas in

				communal lands, Passeriforme birds were the most common using sartenejas. In comparison, we recorded 27 mammal species using sartenejas, 18 in the CBR and 24 in communal lands. The most common species in the CBR was *Urocyon cinereoargenteus*, whereas the most common species in communal lands was *Nasua narica*. Some of the most remarkable species recorded, given their conservation concern, were *Tapirus bairdii*, *Panthera onca*, *Tayassu pecari* and *Spizaetus ornatus*. Bird assemblages differentiated between the CBR and communal lands. However, we did not find differences between mammal assemblages occurring in the CBR and communal lands. For birds, we found that small body-sized frugivorous birds have a higher occupancy within communal lands, whereas medium body-sized frugivorous birds have a higher occupancy in the CBR, there was no any difference in the remaining bird functional groups. In comparison, we found a higher occupancy of large and very large mammalian carnivores in the CBR whereas medium omnivores and large insectivores have a higher occupancy in the community lands.
Knowing how local people use sartenejas				We undertook 30 semi-structured interviews with people from the "Nuevo Conhuas" community. Thanks to these interviews, we were able to locate 10 sartenejas in communal lands, where we set up camera traps. Despite most of the people are from other states of the country they were very knowledgeable about sartenejas occurrence. Moreover, most of the interviewed people knew about animals using water from sartenejas' and believed that they were as important as "aguadas" for the

				wildlife. Among local people, sartenejas water is used to be consumed and for farming activities, Moreover, sartenejas constitute an important hunting spot. Local people are particularly aware of the location of the largest sartenejas because they are the only to maintain water during dry seasons.
Writing scientific papers and reports				We have written reports for the National Commission of Protected Natural Areas (CONANP), which coordinates the operation of the CBR. We are currently writing the first scientific paper derived from this project which we plan to finish by May. Moreover, we are writing an article for a popular science magazine.
Sharing project results with local people and society in general				We have shared the results (e.g., videos of the wildlife) of this project with stakeholders such as people from the community of "Nuevo Conhuas", land managers and park guards from CONANP. Moreover, as a way to raise awareness about the importance of sartenejas to maintain wildlife populations, we have scheduled a workshop with local to be conducted in May.

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

We had planned to set up equipment (camera traps and data-logging rain gauges) in the northern portion of the southern core zone of the CBR where the "Centauros del Norte" village is located. We introduced the project to local people and authorities of "Centauros del Norte" community, unfortunately, we couldn't continue with the corresponding activities due to the fact we were warned about the existence of a high risk of theft of the equipment. Thus, we decided to move the activities we originally planned to do in "Centauros del Norte" to a nearby community with similar characteristics called "Nuevo Conhuas". This community is in the vicinity of the CBR, it has the same type of vegetation and shares the fauna. Thus, the main factor that can be influencing the composition in wildlife visiting the sartenejas is human activity such as was intended originally when including the community "Centauros del Norte" in the study.

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

1. For first time, we estimated density of sartenejas, described their distribution pattern and conducted a detailed account of their main characteristics. This information will help to have a first estimation of the amount of water sartenejas can provide to people and wildlife. We found that there is one sarteneja per every 10 ha, this density is higher than aguadas density (one aguada per every 1,050 ha). We believe sartenejas are essential to promote habitat connectivity by providing a key resource for wildlife.

2. We completed a comprehensive list of the assemblage of vertebrates using sartenejas. It is very interesting to highlight that sartenejas in the "Nuevo Conhuas" community were heavily used by small birds and medium mammals such as white-nosed coati and Central American agouti; we recorded more events in communal lands than in the CBR, which means that sartenejas are a very important resource both inside CBR and in disturbed sites. Inside CBR, we recorded some endangered species using sartenejas; one of the most important records of such species is the with-lipped peccary (*T. pecari*), according with CBR authorities, our record was the only one registered in the year of 2018. This information highlights the potential of sartenejas to monitor wildlife. Furthermore, this project recorded the presence of exotic species such as the coyote which was not previously documented in the area.

3. An important derivation of our work is that we have drawn generated a great interest on monitor sartenejas. Before this project, researches, local authorities and local people were interested just in aguadas, they thought sartenejas were not as important as aguadas. However, local authorities (CONANP) are interested in study and monitor sartenejas. Furthermore, local people from "Nuevo Conhuas" want to monitor some sartenejas by themselves. We have sown the seed of curiosity, even, land owners where we set up camera traps are proud of having a sarteneja in their lands.

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

Local people from "Nuevo Conhuas" community were involved directly in the project. Since the beginning of the project, there was a great interest in having image evidence of animals using these water bodies. They helped us to locate sartenejas and to keep equipment safe. We were constantly working with eight land owners where we set up equipment, and a bigger group of villagers was involved during interviews. This project has helped to show that an alien species is colonising the community, we recorded coyote (*Canis latrans*) using a sarteneja located to 3 km from the village; local people were surprised when we showed the coyote videos because they thought that this species was not present in the community. This information can be used to apply to federal funded initiatives such as payment for ecosystem services.

Moreover, we trained two young local boys on how to use the GPS, camera traps, data-logging rain gauges, download files from SD cards and store them in a computer. They received a stipend for working in the project as field assistants. The National Commission for the Knowledge and Use of Biodiversity (CONABIO) is planning to conduct a nationwide scale survey of wildlife using camera traps and Sherman traps operated by local people who will be paid for their collaboration in the project. We contacted CONABIO to have the community of "Nuevo Conhuas" as a candidate to be included in their project. This will represent an additional source of income for local people.

5. Are there any plans to continue this work?

Yes, we are planning to continue with this project. We would like to establish a long-term monitoring programme. The first step in relationship to this goal would be to monitor sartenejas during a second year. The type of information we are generating in this project has recently acquired a major relevance due to the fact the recently elected president has as one of his main initiatives to build a touristic train in the region in which our study site occurs (Mayan train). It is expected that the Mayan train will attract 3 million visiting people per year; such quantity of tourists will likely stem a wave of infrastructure development and establishment of new population settlements generating a large demand of land and resources such as water. These changes will likely affect wildlife populations; our data will provide a greatly needed baseline to assessing the impacts brought about by these changes.

There a great opportunity to build a sound database to assessing the impacts of increased tourist affluence to the CBR on wildlife due to the fact CONANP and "Nuevo Conhuas" community record the time and the number of tourists that access to the CBR.

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

Results are part of my MSc degree thesis, which will be defended in August-September 2019. We have been sharing the results with people from de "Nuevo Conhuas" community and with the local authorities of the National Commission of Protected Natural Areas by reports and videos from camera-traps. Results of this project will be summited to a peer-review journal, we are planning to send a manuscript to Biological Conservation. Furthermore, we are planning to have a Facebook page and a ResearchGate project focused on wildlife videos dissemination.

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

This grant was used for a period of 13 months (January 2018 to February 2019). We extended the length of the project for a month because during the first field trip field work focused primarily on searching sartenejas.

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
Researcher accommodation	565	490	75	It was cheaper than we expected.
Fuel for motorbike	77	384	+307	We did not consider that we should travel more than 30 km a day. Furthermore, fuel price has increased 13.6% since we submitted our proposal (from £ 0.77 to £ 0.88 per litre).
Rent of motorbike	338	338		
Transportation from Campeche City to Calakmul	175	175		We are including transportation to airport in Mexico City (approximately £12 each field trip)
Round-trip fly tickets from Mexico City to Campeche City (Campeche)	910	765	-145	We decided to travel to Chetumal airport (Quintana Roo) because tickets were cheaper, and it takes less time to arrive to Calakmul.
Payment of field assistant	750	750		
Food for the work team	1,125	1,050	-75	We usually had food in the "Nuevo Conhuas" eateries to contribute to the local economy.
Oyster™ Portable pH/Conductivity/TDS/ORP/Salinity Kit	366	366		
GRS Densiometer	83	83		
Cuddeback E3 Black Flash No Glow Infrared Game	611	608	-3	We bought another camera-trap brand because Cuddeback E3 Black Flash was discontinued. We bought Browning Trail Cameras Strike Force Elite HD 10MP.
TOTAL	**5,000**	**5,009**	**+9**	

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

The most important next steps are:

1. To integrate and synthesise the information gathered during this project. We share our results among the scientific community and stakeholders.
2. To share the results with a bigger audience. We have shared the results with people from "Nuevo Conhuas" community, other students and researchers. However, we think that it is crucial to share these results with general public.
3. Our data is showing that sartenejas are as important as aguadas, thus, we should incorporate these water bodies in biodiversity long term monitoring programmes in the Calakmul Region.

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?

We have not used the RF logo yet in any materials, however, we are planning to use some camera trap photos to make a small field guide for local people. The CBR has a very important archaeological site (Calakmul), every year it receives thousands of tourists, and some of them are interested on wildlife. Thus, some villagers have been trained to be tourist's guides, they have been asking for a field guide to show wildlife to tourists. However, we have been using RF logo in different power point presentations in the acknowledgments section.

Rufford Foundation received some publicity with our colleagues. Furthermore, C. M. Delgado-Martínez visited Tsinghua University to do a research stay during September-October 2018, during that time, he talked about this project and Rufford Foundation to students from China, India, Indonesia and Pakistan. We gave some advices to a Pakistani PhD student to write a proposal for Rufford Foundation.

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

Carlos Mauricio Delgado Martínez. Applicant and principal investigator. He conducted most of the fieldwork and data processing.

Eduardo Mendoza Ramírez. He provided support on the study design, data analysis and manuscript preparation.

Gabriel Gutiérrez Granados. He helped on data analysis and revision of reports.

Melanie Kolb. She provided support on the study design and shared some equipment (GPS and Walkie Talkies).

Margarita Reyes Santos. She provided support with protozoa identification in water samples.

Andrés Barrientos Ramírez. Field assistant, he has helped us with field activities such as looking for sartenejas, introducing the project with the local authorities and checking the equipment.

Rubicel Damián. Field assistant, he has helped us locating sartenejas in the community lands and checking the equipment.

12. Any other comments?

We sincerely thank to Rufford Foundation for supporting this project in the Calakmul Region. Without this grant, it is highly probable that this project would not have been conducted. Furthermore, this grant has allowed to C. M. Delgado Martínez to conduct his MSc degree project and to raise up interest on this water resource in the region.