

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	Richard Joyce
Project title	Diversity and ecology of native bees in southwest Nicaragua
RSG reference	18672-1
Reporting period	January 2016-May 2017
Amount of grant	£4964 (amount received was approximately £4830 due to bank fees or exchange rate differences)
Your email address	richard@pasopacifico.org
Date of this report	10 May 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
Sampling of native bee species in the field				We collected a total of 1,400 specimens, with a total of 204 sampling days spanning 16 months. One of the species we detected, <i>Bombus mexicanus</i> , was recently assessed as Vulnerable by the IUCN.
Produce an annotated checklist of bees of the Paso del Istmo region				This document is currently in progress, pending identification of remaining specimens. Forty eight types were identified definitively to species level— when morphospecies are included, the number of unique taxa is more than 70.
Design and implement Junior Ranger curriculum about native bees.				We designed a five-part environmental education module that has been incorporated into Paso Pacifico's Junior Ranger programme and will reach 100 children from local communities each year.
Design and distribute educational poster				Design of a poster highlighting native bee species and plants and crops providing floral resources has been completed.
Determine habitat associations of bees				Our bee species occurrence records, combined with observations of floral visitation and nesting habits, shed light on the relative ability of bee species to exploit different habitats, including forests and agricultural landscapes.

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

There were considerable delays in the procurement of our research permit and the transportation of specimens to Mexico where they were identified. (Our first batch of specimens was detained for more than 6 months.) This required patience,

persistence, and flexibility. We also used macrophotography to identify some of the specimens, confirming identifications with taxonomic experts in Neotropical bees, in order to circumvent the challenges posed by transporting specimens.

The beginning of our field season in 2016 fell at the height of a 3-year drought, made worse by the El Niño phenomenon. This led us to extend specimen sampling into the dry season of 2017 in order to sample at plants which failed to flower in 2016.

Pan-trapping proved to be an inefficient and ineffective sampling method compared to hand-netting, so we ultimately chose to prioritise active sampling with handnets, focusing on species diversity and floral resource plants.

Marcos Calero Pérez, the field technician, fell from a tree and fractured his leg at the end of October, which meant that sampling was limited during November 2016. Thankfully, he recovered quickly.

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

- a) We identified crucial plant species that provide floral resources to native bees at various points in the year. These species range from traditional food crops to early successional species, to forest trees. Paso Pacifico will promote these species in diversified agroecosystems, riparian corridors, reforestation efforts, and living fence rows.
- b) Through our sampling efforts and parallel meliponiculture activities, we reached 13 households that keep native stingless bees (in seven different communities), generating knowledge about, and interest in, the native bees of southwest Nicaragua and the flower species they visit. Furthermore, we developed an educational curriculum about native bees and pollination which has been incorporated into Paso Pacifico's Junior Ranger programming. This programme reaches about 100 local children on an annual basis.
- c) With over 1,400 specimen records of 70 types (48 identified to species level so far) we established base-line occurrence data for bee species in the focus region, as well as observations of specific species interactions between native bees and flowering plant species. These data will allow us (and other researchers) to carry out long-term monitoring of bee taxa (such as *Bombus mexicanus*, orchid bees and stingless bees), as well as facilitate pollination research in the region.

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

The most significant local beneficiary was Marcos Calero Pérez, the project's field technician, who lives in the region and comes from an agricultural background. Marcos has successfully learned field sampling techniques, botanical identification, specimen care, and data management. He showed an exemplary level of competence and pride in his work, as well as a sustained interest in the local bee fauna.

Local community members were generous in both offering access to their land and sharing traditional knowledge about native bees. Paso Pacifico runs a meliponiculture (stingless bee keeping) training programme, and visits to 14 bee keeper households were often combined with sampling trips. We are now prepared to advise bee keepers and farmers about plant species that will promote.

On many occasions, we took the time to explain our work to local children, who displayed curiosity about the project. A native-bee module has been added to the curriculum of Paso Pacifico's Junior Ranger programme, which reaches over 100 children annually.

5. Are there any plans to continue this work?

Paso Pacifico plans to incorporate recommendations in both reforestation activities and outreach to farmers on land management. This will mean including key native bee-sustaining species in reforestation activities and promoting bee-supporting crops (such as annato, vegetable pear, and coconut) and living fence post trees in agricultural systems.

I created a project titled "Native bees of Nicaragua" on the online citizen science platform iNaturalist. This will serve as a publicly available repository of georeferenced bee records in Nicaragua, as well as a reference for identification. <https://www.inaturalist.org/projects/abejas-del-paso-del-istmo-departamento-de-rivas-nicaragua>

With matching funding, we will print and distribute the educational native bee posters which we have designed.

Programming for Paso Pacifico's Junior Ranger begins in May 2017. Young participants will engage in hands-on, interactive activities to learn about pollination, native bees, and pollinator conservation.

Paso Pacifico plans on designing a monitoring protocol to implement each dry season in order to assess and track changes in the region's native bee species assemblages.

Paso Pacifico plans on building off of the partnerships that it has built through this project with ECOSUR in Chiapas, Mexico as well as other pollinator conservation organisations in Latin America to continue studying, protecting and promoting native bees as crucial pollinators in forests and on farms.

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

Once all of the specimens have been identified, I will submit a bilingual annotated checklist to the Nicaraguan Entomology Journal (Revista Nicaragüense Entomológica). Species occurrence records will be published to the Global Biodiversity Information Facility.

We have already shared our preliminary results with Nicaragua's Ministry of Environment and Natural Resources, both in a written report and a presentation.

We have shared hundreds of images of native bees through the digital citizen science platform iNaturalist, as well as with networks of bee researchers, bee keepers and bee enthusiasts. We have shared preliminary results with two native bee-focused organizations in Nicaragua: Meliponas de Nicaragua and Centro de Entendimiento con la Naturaleza.

Funding permitting, Marcos Calero will attend the 10th Mesoamerican Congress on Native Bees in November 2017 in Antigua, Guatemala to share the projects findings. Results will also be shared with the 13 households of stingless-bee keepers in the region who Paso Pacifico works with to improve honey production and hive health.

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

Funds were used between January 2016 and April 2017. Funds were used faster than anticipated, largely due to the travel expenses of the field technician. Although we had originally planned on limiting sampling to 12 months, we chose to continue collecting specimens into the dry season of 2017 with the hope of detecting species that were absent during the extraordinarily dry season of 2016. Some of the outreach activities will be carried to completion in the coming months.

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
Entomological supplies	545	401.42	-143.58	We received a donation of wooden insect boxes from an ecologist in Costa Rica.
Compensation of field technician	2964	3030.32	-66.32	This includes labour benefit required by law in Nicaragua.
Fuel for transportation	780	612.32	-167.68	Some fuel costs were avoided by using bus transportation when possible.
Technical assistance with species identification	650	0	-650	The taxonomists at ECOSUR were eager to receive the specimens and did not charge for identification services.

Internet and communication costs for local field technician	195	300	105	Internet was frequently needed for sending updated specimen data and photos of flowers to identify.
Design and printing of educational posters	325	299.82	-25.18	Design took longer than anticipated. Paso Pacifico will obtain matched funding for printing the posters.
Implementation of native bee environmental education with Junior Ranger Program	975	0	-975	The curriculum was developed by me and will be executed with Paso Pacifico's own funding beginning in May 2017.
Food expenses for field technician	0	484.34	484.34	Meal costs when the field technician spent the night away from his home town for field sampling.
TOTAL	6434	5128.22	-1305.78	On December 8, 2015, the exchange rate was \$1.5009 to 1 pound. On December 8, we received \$7, 249.74, or approximately 4,830.26 pounds, which is 134 pounds less than the total amount from Rufford in our budget.

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

First, the remaining specimens must be identified and curated in permanent collections.

Second, it is important to make the findings of this study actionable by making sure they are available in both English and Spanish to conservation practitioners in the region. This includes the Private Reserves Network, the Ministry of Environment and Natural Resources, keepers of native stingless bees, and landowners interested in sustaining pollinator diversity on their properties.

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 used the RSGF logo on both the educational poster and the environmental education curriculum manual. I also gave two slideshow presentations to University of California tropical biology students in which I used the RSGF logo and spoke about Rufford as a funding source for conservation research in the tropics.

Paso Pacifico featured the Rufford Foundation in several social media posts (Facebook and Instagram).

The Rufford Foundation will be acknowledged in Paso Pacifico's 2016 Annual Report, as well as at the 10th Mesoamerican Congress on Native Bees in Antigua, Guatemala, in November 2017.

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?

It has been rewarding to become a part of the Rufford network of researchers and conservation practitioners and to learn from similar local studies being carried out in the tropical Americas.

Thank you for believing in and investing in our local, on-the-ground efforts to understand and protect biodiversity.