

The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. 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. 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	Diego Alejandro Zarate Caicedo
Project title	Primates as process facilitators in the regeneration of native vegetation in anthropogenic landscapes
RSG reference	10084-1
Reporting period	August 2011 – August 2012
Amount of grant	£5834
Your email address	dzarate@oikos.unam.mx
Date of this report	10/15/2012

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Thanks to the help of the Rufford Small Grants Foundation and other funding sources, it has been possible to develop the majority of the objectives proposed in this study. However, we expect that all the objectives will be completed in a short time. In ecological terms, our achievements include quantification of the activity patterns, diet, use of space and seed dispersal in three groups of black howler monkeys that live in shaded cocoa plantations and three groups that inhabit continuous forest adjacent to the cocoa plantations. At the same time, we quantified seed flow across the cocoa plantation-forest border (by estimating seed rain, plant diversity within a 1 m² plot, and the diversity of parent trees around each plot) in order to estimate the influence of the howler monkeys on native tree regeneration within these agroecosystems. Finally, we determined the post-dispersal fate of *Brosimum lactescens* and *Passiflora edullis* (removal-depredation, germination or seedling survival). In terms of the social aspects of the project, eight local farmers were employed throughout the entire study period: they not only worked as field assistants but also received training in the use of field equipment and in the implementation of the sampling methods developed as part of this study. Finally, in terms of environmental education, we conducted visits, incorporating talks and games with the children of the local primary schools, fostering friendship with nature and teaching the importance of maintaining the black howler monkeys in the shaded cocoa plantations that belong to their parents.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Ecology, behaviour and seed dispersal by <i>Alouatta pigra</i> in cultivated cacao vs. continuous forest.		X		To date, we have conducted four out of five planned field studies concerning the ecology, behaviour and seed dispersal of six howler groups (three in the cocoa plantations and three in the adjacent forest). These studies have benefitted from the participation of local <i>campesinos</i> , acting as field assistants during the long days of monitoring.
Evaluation of the contribution of nutrients from the howler monkeys to a cacao plantation.	X			This objective has still to be met. However, soil samples will be collected during forthcoming field sampling trips, and analysed in the soils laboratory of the Universidad Nacional Autónoma de México.
Post-dispersal fate of seeds and seedlings of tree species dispersed by the howler monkeys in shaded cocoa crops and in the forest.		X		For this objective, we chose two species of seeds dispersed by the howler monkeys during the study period (<i>Brosimum lactescens</i> and <i>Passiflora edullis</i>). In the case of <i>B. lactescens</i> , the experiments of removal-depredation, germination and growth began in August 2011, while those of <i>P. edullis</i> began in July 2012. One very important aspect of this

				objective has been the participation of the local field assistants who, following thorough training, assisted us with the determination of post-dispersal seed fate during periods when we were absent from the site. Through this, the field assistants became invaluable contributors to the study.
Seed flow and regeneration of native trees across the cocoa plantation-forest border.			X	For this objective, we selected 3 transects along the length of the cocoa plantation-forest border, with the aim of quantifying seed flow and contribution of the howler monkeys to the regeneration of native trees in the shaded agroecosystem. To do this, over the period of a year we monitored 30 seed traps and 60 1 m ² plots. We also conducted an inventory of trees with a DBH > 10 cm within an area of 40 m ² surrounding each plot. The field phase of this objective is now complete, but we still have to identify the seeds from traps and perform the subsequent analysis. The participation of the local farmers, such as Señores Rafael Lombera and Hugo Baldobinos, was once again critical to the completion of the objective.
Socialisation of the methodology and training in the use of equipment			X	One of the main goals at the social level was to provide the people of the community with employment opportunities while also training them in the implementation of different field techniques, use of equipment and identification of their own native flora. It was hoped that, in the long term, they could develop their own local environmental initiatives or secure further gainful employment in their region as field assistants, allowing them an alternative to hunting and logging by which to make money. In this case, we contracted and trained eight people from the <i>ejidos</i> of Chajul and Playón de la Gloria throughout the project. They received a salary, in some cases permanent, and are currently participating in sampling and collection of data for the project.

<p>Programme of environmental education in the schools of the region</p>		<p>X</p>		<p>This objective was aimed at the 40 children of the primary schools of the <i>ejidos</i> Chajúl and Playón de la Gloria. We divided activities into three stages: educational talk (using video, photographs and stories), expression (where the children demonstrated through drawings what they thought of nature and care for the howler monkeys) and a session utilising souvenirs (photographs of howler monkeys were raffled and a colourful brochure was delivered containing information about howler monkeys and their relationship with the cocoa crop). We hope to visit more schools and reach more children in the coming months.</p>
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2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

1. Methodological modification: In order to measure the contribution of black howler monkeys to native tree regeneration in the cocoa plantations, we initially proposed an experimental design consisting of nine sampling sites. These included three shaded cocoa plantations with monkeys, three without and three located within the continuous forest. However, once we researched further into the history of each site, we decided to rethink the original design because the cocoa plantations with no monkeys presented us with three problems: 1. The land use history of the cocoa plantation without monkeys was different to that of the shaded plantations with monkeys, 2. The shade trees were planted and consisted of a small number of non-native species, and 3. Due in all likelihood to the proximity of the river Lacantum, the soil characteristics of texture and nutrient content could differ between the cocoa plantation with monkeys and the continuous forest. Instead, we decided to determine the seed flow and regeneration of native trees across the cocoa plantation-forest border. In order to determine the role played by black howler monkeys, and other vectors of primary seed dispersal, in the flow of seeds between the cocoa plantations and the adjacent forest, and to quantify the establishment of plants of different dispersal syndromes, we defined three 500 m transects along the length of the cocoa plantation-continuous forest border. Along each transect, we established 10 “stations” at a distance of 50 m apart. At each station, we set up: one seed trap (total of 10 per transect) and two 1 m² plots in which to record seedlings (total of 20 per transect). In addition, we conducted an inventory of trees of DBH ≥10 cm in a 20 m radius around each station.

2. Difficulties with *Brosimum lactescens*: One of the objectives of this study was to determine the post-dispersal fate of two seed species dispersed by black howler monkeys and to determine whether habitat type (cocoa plantation vs. forest) has any effect on seed removal, germination or seedling survival. In the case of the germination experiment featuring *B. lactescens*, we initially collected 300 seeds from different trees of this species and placed them in five monkey sleeping sites and five non-nesting sites in each one of the six chosen sites (600 seeds totals; 3 shaded cocoa plantations and 3 sites of continuous forest). Each seed was covered by a 0.5 cm² metal mesh to prevent removal, but not covered with dung. Once in place, seeds were revised weekly until

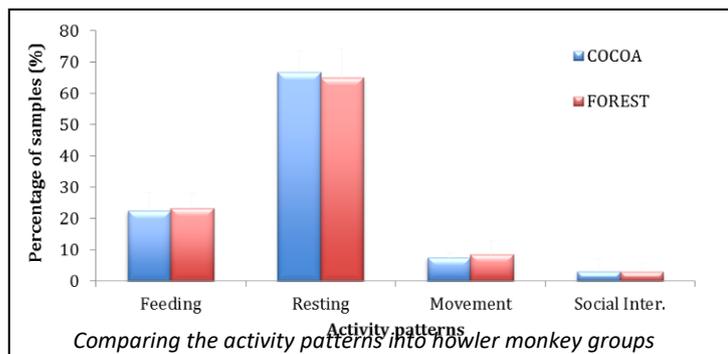
germination or deterioration (rotting). However, despite the fact that we expected a high rate of germination, only 3% of the seeds germinated. Two were established in one of the cocoa plantations but only one seedling currently survives (length = 12 cm – Leaves number = 3). Two possible explanations for this low rate of germination could be the level of rainfall during the season or seed handling. We therefore decided to repeat the experiment. The new experiment was conducted over the same season of the following year and some 73% of the seeds germinated. This suggests that, given the fact that the levels of rainfall were similar to those of the previous year, handling of these seeds can affect their germination.

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

This information is based on preliminary results

1. Behavioural ecology of black howler monkeys in shaded cocoa plantations vs. continuous forest:

Individual focal called "Barto"



On comparison of the pattern of activity, diet and use of space presented by the groups that inhabit the shaded cocoa plantations vs. those of the continuous forest, no significant differences were found. In general, the black howler monkeys present in both habitats invest in average 65.9% of their time at rest, 23.4% feeding, 8.1% in transit and 3.1% in social interaction. In terms of feeding, 63.1% of their diet is made up of leaves, while 26.7% consists of fruits. *Brosimum alicastrum* was the most consumed species. The average daily distance travelled was 345.6 m, while the average home range was estimated to be 1.03 ha. These data suggest that the physical and biological characteristics of the cocoa plantations have no apparent effect on the behavioural ecology of the black howler monkeys, since our partial results do not show differences between the two habitats. In conclusion, shaded cocoa plantations represent an important habitat for the black howler monkeys, since they provide an alternative living area, with available resources, as well as areas for rest and reproduction.

2. Black howler monkeys contribute to the regeneration of tree species and native lianas in shaded cocoa plantations (movement and dispersal of seeds). To date, 61 dispersal distances have been estimated for eight species dispersed by black howler monkeys. These distances range from 7 to 439 m, where 51% of the recordings correspond to distances greater than 100 m (141 m in the cocoa plantation and 92 m in the forest). In terms of seed dispersal, a total of 581 individual defecations have been collected, 273 in the cocoa plantation and 308 in the forest. In total, and considering all the seed



Seeds dispersal collected

sizes dispersed, the six groups of howler monkeys have dispersed more than 90,000 seeds of 18 different plant species (> 80,000 in the cocoa plantation and > 10,000 in the forest). These results show that, at least in this case, black howler monkeys that inhabit the shaded cocoa plantation can maintain values of seed dispersal comparable to, and even greater than, those groups that live in continuous forest. This suggests that, even in this type of anthropogenic environment, howler monkeys can actively participate in the processes of regeneration of the native tree and liana species present in shaded cocoa plantations.

3. Social aspects of the process of investigation and environmental education: Another key aspect

of this work was the participation of the rural community and the school children of the *ejidos* Playon de la Gloria and Chajul. We provided a work opportunity while raising the awareness of local people. We believe we were successful in teaching adequate research methodologies and stressing the need to develop local projects for the conservation of resources. But beyond this, we believe that our assistants have developed an awareness of protecting their environment and in particular have recognised the value of native shade trees present in the cocoa plantations to the lives of many groups of howler monkeys that have adapted this human system to be their home. Moreover, with the school visits and meeting different children, trying to teach them with stories, photos, drawings and videos about the life of the howler monkeys, where they live, eat, how they are organised, what their function is, why we must protect them and why they vocalise, etc., we have been able to see their excitement and fascination with these animals, that in many cases are simply part of their gardens at home.



Environmental education activities



People of the rural community that participated in this investigation

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



Rural assistant worked

In this project, interaction with the local community has occurred in two ways. Firstly, we have worked directly with various people of the community (Rafael Lombera, Hugo Baldovino, Isidro López Lira, Miguel Miranda, Moisés Miranda, Isaías Lombera, and Gilberto Amangape, among others). This has enabled us to directly show them why and how this work is done, while simultaneously bringing them closer to nature, but not from the perspective of a hunter or farmer, but of a naturalist who seeks to understand the surrounding natural phenomena. For example, on seeing directly the dispersal and post-dispersal processes of seeds, they can realise the necessity of preservation and maintenance of the primates in their natural environment, or on seeing that the monkeys urinate and defecate around and within the cocoa crops, they see directly how these monkeys can benefit their crops through fertilisation. We involved the children of the local schools, through animated talks with video and photos of the howler monkeys in the forest and cocoa plantations. We also delivered a brochure containing all the

information about the function and care of the howler monkeys and, at the end of the activities; they expressed their thoughts regarding the howler monkeys and nature through drawings. Needless to say, however, there are many problems facing the children at these rural schools for the lack of material resources such as books, desks, chairs, computing equipment and more suitable physical conditions. This greatly hinders the teaching and learning of basic concepts and even more so when dealing with aspects of such importance such as their natural resources (e.g. howler monkeys). Without doubt, these children represent the future of this region and, as such we believe they deserve more attention.



Environmental education program: We try to teach to the childrens with stories, photos, drawings and videos about the life of the howler monkeys

Regarding economic benefits, we believe that the local community has been favoured by this project in various ways: Firstly, our field assistants have received a basic salary that represents a promising alternative to the high unemployment of the region or hunting for subsistence or sale of meat or animals as pets. Likewise, learning the methodologies of biological sampling and handling of equipment has enabled some them to obtain more work in projects of other researchers from UNAM who work in the area, emerging as a new long-term alternative source of employment for the community.

5. Are there any plans to continue this work?

This work is going to continue for a further period of time. Our main idea is to complete all the objectives that we have set for the long term. Currently, we are being supported by other sources of funding until 2013; however, this funding only covers the final stage of research for this doctoral project. We therefore believe that it is important to continue and to focus on social aspects and on environmental education regarding the conservation of black howler monkeys in the shaded cocoa plantations. For this, sustainable management alternatives of the productive crops could be created with the community, as well as plans for ecotourism that integrate both productive and abandoned plantations. This could reduce or even prevent logging of shade trees and the loss and replacement of the cocoa plantations by livestock production or other activities detrimental to biodiversity. Similarly, a permanent programme could be created to teach environmental education in the schools of the region, training the teachers about local natural resources, their importance and their environmental function.



Logging the shaded trees in a cocoa crop from Playón de la Gloria, Chiapas

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



Informative brochures

this study). The proposed documentary could be distributed freely to the community and could reach many homes in the region. We intend to seek funding in order to develop this activity.

Local community: At local level we are delivering informative brochures describing the natural history of black howler monkeys and their importance as seed dispersers and sources of fertilizer for the soil in the shaded cocoa plantations. We also plan to share our final results soon with the community in general. This will be achieved through informational talks at *ejido* assemblies and in schools in the region. Likewise, we are interested in making a video documentary regarding the behaviour of the black howler monkeys in the shaded cocoa plantations (we have recorded a great deal of footage showing howler monkey behaviour as part of

Academic sphere: At the academic level, we have already begun to share our preliminary data with part of the primatological community. We presented a paper at the XXIV International Primatological Society Congress entitled: "SHADED COCOA PLANTATIONS PROVIDE HABITAT AND FOOD RESOURCES TO HOWLER MONKEYS AND WOOLLY MONKEYS IN MEXICO AND COLOMBIA". We also plan to present a paper at the 2013 ATBC congress. Moreover, this study is my doctoral thesis, which we plan to divide into at least three peer-reviewed scientific articles, discussing: 1. The behaviour and ecology of the black howler monkeys in shaded agroecosystems, 2. The role played by black howler monkeys in the regeneration of anthropogenic landscapes, and 3. Post-dispersal fate of seeds dispersed by black howler monkeys in shaded cocoa plantations.



International congress oral presentation

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

The funds donated by RSG were used over the period of one year between August 2011 and August 2012. However, as anticipated, the project itself may continue a little longer.

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
1 FIELD ASSISTANT	1838	2300	- 462	We used more grant money in order to contract more field assistants from the community.
1 BINOCULAR (NIKON 10 X 50MM)	96	95	1	Nikon 10 x 50 mm binoculars were acquired for the project.
1 GPS (Garmin GPSMAP 76csx)	296	148	148	We preferred to buy the Garmin 72H GPS, which is similar to the 76 CSX but a little less expensive.
1 HP iPAQ 211 Enterprise Handheld	229	200	29	The HP iPAQ 216 microcomputer was acquired for the project.
4 trips (by land) Morelia-Chajul-Morelia	1271	1300	- 29	This money was used for return journeys between Morelia and Chajul and to buy petrol for the transport at the study site.
Food in Chajul	873	900	- 27	This money was used to buy food during the sampling periods.
Field station fees in Chajul	1103	763	340	This money was used to pay the rental of the accommodation used during my fieldwork. The difference is due to changing accommodation to another which was more

				economical and practical
Materials	128	128	0	This money paid for materials such as marker pens, notebooks, tape, batteries etc.
TOTAL	£5834	£5834		

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

Limitations in the protection of howler monkeys in the shaded cocoa plantations of the Lacandon Tropical Forest: One of the most important results of this study is that black howler monkeys can utilise shaded cocoa plantations, shaded by native tree species, as a potential habitat in terms of



living space, source of resources and area of reproduction and rest. However, many groups of black howler monkeys that currently live in shaded cocoa plantations, whether abandoned or under active management, are under threat because of the farmers need to increase production of their cocoa crops or to substitute them with a more economically viable crop. We therefore believe that it is necessary to dedicate a greater investment of time and money in training and the management of the cocoa crops in order to increase production without having to reduce the shade tree cover, or in other cases where the crop may not be productive, to design strategies to promote local ecotourism that can represent an economic input to the farmer and enable the maintenance of the cocoa crop. We initiated some approaches and talks to the plantation owners, however this is a point that deserves much more attention in the future and merits the continuation of the project albeit from a completely social perspective

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

We have used the RSGF logo in all the presentations given to the schools of the region, as well as in the presentations given at the Universidad Nacional Autónoma de México. In addition, the logo has been included on more than 1000 brochures distributed throughout the community and in the oral presentation given at the international primatological congress. We will, of course, always recognize the invaluable contribution of RSGF, in terms of support and funding, in the acknowledgements of any future publications pertaining to this work.

11. Any other comments?

This project recognizes and values the assistance that has been given to us from the Rufford Small Grants Foundation with their generous financial support. Thanks to this help, we have been able to develop our research and social work in order to contribute to the understanding and conservation of black howler monkeys in the Lacandon tropical forest and in the shaded cocoa plantations of this region.



RSGF logo used in all presentations: Environmental education program, international congress and informative brochure