

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	Jenny Zambrano
Project title	Effects of forest fragmentation in the life history of an animal dispersed tree at Los Tuxtlas, Mexico.
RSG reference	47.12.09
Reporting period	May 2010-July 2011
Amount of grant	£4885
Your email address	jzambr3@uic.edu
Date of this report	July 2011

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
Set up of 8 permanent vegetation plots			X	
Set up of fruits and seeds removal experiment			X	
Set up of seed and seedling growing experiment			X	An seed growing experiment was set up to further investigate the effects of forest fragmentation on seed quality and seedling performance
Set up of vegetation transects			X	Eleven vegetation transects were set up at each habitat in order to assess spatial distribution of <i>Poulsenia armata</i> and test for seed dispersal limitation
Population models		X		Data from 2011 is in the process of being analysed
Set up camera traps and rodent census			X	

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

No difficulties to report.

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

1. Population structure of *P. armata* is affected by forest fragmentation due to lower recruitment of fragmented populations compared to populations in the continuous forest. Between 2009 and 2010, eight permanent 1 ha plots were established at the area of Los Tuxtlas forest located in the state of Veracruz, Mexico. All the individuals were marked and divided into life stages based on information on the population structure from the literature and from field observations. Six life stages were determined for this study as follows: 1-year seedlings, older seedlings, juveniles, saplings, young adults, and reproductive adults. In addition, twelve 40° wedge-shaped transects were set up at each habitat (continuous/fragments), extending 30 m from the base of the adult trees. All the individuals were marked and distance recorded from each adult tree. Eleven more transects were set up in 2010 in the forest fragments in order to assess any changes in the spatial distribution of *P. armata* in the fragments compared to the continuous forest.

I found considerably fewer old seedlings, juveniles and saplings in the forest fragments ($P=0.004$) while 1-year seedlings represented almost 65% of the entire population. This suggests strong mortality of 1-year seedlings in fragments as a result of high density dependent. Moreover, from the vegetation transect I found a significant interaction

between age and habitat ($P < 0.0005$) with more 1-year seedlings in fragments but fewer older individuals in continuous forest. In addition, more 1-year seedlings recruiting close to adult trees in fragments, suggesting high density dependent mortality occurring in fragments due to limited seed dispersal. Finally, there is better survival and transition of 1-year seedlings in continuous forest even if fruit and seed predation is higher in the continuous forest than in the fragmented ($F = 5.321$, $df = 1$, $P = 0.029$). This was supported by the low number of occurrences of trapped rodents as well as the low number of large and medium mammals captured by camera traps. Synergistic effects of hunting and fragmentation are believed to have severely reduced large and medium-sized mammal populations at Los Tuxtlas that are still present in the continuous forest, but are nearly extinct in the small fragments.

2. Seed quality is being affected by the fragmentation of the forest

In 2010, fruits were collected under reproductive adults, and an equal number of seeds were selected randomly (160 seeds from the continuous and 160 from fragments), and germinated in a growing house at the Biological Station. The objective was to determine if seed origin (continuous/fragments) and soil type (continuous/fragments) would have an effect on seed germination and growth under the same conditions. The proportion of germinated seeds and the total growth over a year was recorded.

From the growing experiment I found that seed origin had an effect on germination while soil origin didn't have an effect on germination or seedling growth. Seeds coming from the forest had a significantly higher germination rate than seeds coming from the fragments ($X^2 = 20.81$, $df = 1$, $P < 0.0005$). In addition, seeds originating in the continuous forest had a better survival after a year when compared to seeds originating in the fragmented forest.

These findings seem to follow a pattern congruent with habitat origin, suggesting a change in seed quality resulting from fragmentation, compromising population fitness. Results from data loggers installed at each vegetation plot, showed a considerably higher temperature and luminosity in the fragmented forest. Changes in microclimatic conditions could be affecting seed quality, seed performance and survival. In addition, I found a considerable difference when water content was estimated for seeds from each vegetation plots, with seed from the continuous showing higher water content.

3. Reduced recruitment is limiting population growth of *P. armata*

With the data from the 1 ha vegetation plots, I was able to calculate the population growth rate for both habitats. In addition, I was able to determine demographic parameters such as probabilities of survival and growth (individuals making it to the next life stage), and fecundity. Populations from the fragments showed a higher growth rate between 2010 and 2011, and when compared to continuous forest. But this increase is explained by the large number of 1-year seedlings in the plots. As mentioned before, almost 65% of populations in fragments are represented by 1-year seedlings. In addition probabilities of survival and growth of 1-year seedlings were lower for populations in the fragments as well as growth probabilities for old seedlings and juveniles. Therefore, few individuals from early life stages are passing to late life stages limiting replacement rate and possibly reducing the chances of surviving in a changing environment. In order to further investigate if reduced recruitment of early stages could affect population growth in time, I projected the population of *P. armata* into the future to observe the behavior in 25 years, 50 years, and 100 years. The

demographic parameters calculated before were integrated into population models with the help of the program MatLab. Results showed that growth and survival of early stages could affect population growth and the strong mortality of 1-year seedlings and limited recruitment overtime could affect population viability.

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

I hired local people to assist me in field work in 2010 and 2011. From my past experience, I strongly believe in working with local people in field research since they have a strong impact in wildlife conservation. It has been necessary to work closely with people from the local communities adjacent to the Biological Station. Training local people to monitor the vegetation plots has been a success for this project, and has helped to raise concern about the negative impact of habitat fragmentation on forest persistence.

5. Are there any plans to continue this work?

I plan to continue the monitoring of the vegetation plots and transects in 2012 as well as the monitoring of the growing experiment in order to achieve my PhD In the future, I plan to link these demographic results to the genetic history of the populations in the continuous and the fragmented forest. Lost of genetic diversity, as a result of forest fragmentation, can severely reduce population viability. But very few studies have evaluated the genetic consequences of fragmentation. In order to be able to determine clear-cut conservation strategies, it is necessary to fully consider all the possible effects that forest fragmentation can have on tree populations.

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

I plan to publish my results in high impact peer reviewed scientific journals, such as *Ecology*, *Conservation Biology* and *Proceedings of National Academy of Sciences*. I will also present my work at scientific conferences, most notably, the Ecological Society of America meeting in 2012.

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

The Rufford Small Grant was used for work in the summer months (May-July) of 2010 and 2011. My original plan to return in October of those years was cancelled due to anticipated complications of the rainy season

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
Round trips from Chicago to Mexico City X4	1592	524.24	1067.76	Only two round trips were necessary for the development of this project
Bus tickets X 4	377	292.03	84.97	This increase is from car rental, which was indispensable for this project in

				order to be able to move between the study sites.
Station fees = £ 15.4/ per day X 5 months	1415	1025.7	389.3	Less time than previously estimated was necessary at the Biological Station
Salary for 1 research assistant =£184/month X 5 months	827	1308	-481	Salaries were miscalculated since they were base on a rate from 2008
Local labour =£ 16.4/per day X 1 month	184	654	-470	Help of an extra assistant was necessary in 2010 in order to set up the vegetation plots, which increase the budgeted sum for local labour
Camera trap	164	0	164	Camera traps were provided by Idea Wild.
Flags, thread, glue, PVC tubes, plastic bags	326	952.6	-626.6	The use of data loggers to assess abiotic conditions was indispensable for this project. This increased the budgeted sum for materials.
TOTAL	4885	4756.57	128.43	1 GBP= 1.410900 US Dollar

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

Results from the growing experiment suggest a change in seed quality that could be the result of a maternal effect or a lost in genetic diversity. Therefore, in order to have a better understanding of how forest fragmentation could be affecting the survival of forest species, it is necessary to incorporate a genetic analysis into the demographic study. In addition, I plan to disseminate the results of my study in order to propose conservation strategies for the area, where very few studies on the remaining flora have been conducted. The use of population models can be use as a powerful tool in conservation when a prompt action is required.

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?

I use the RSGF logo in a presentation at the University of Illinois in Chicago during 2011 where I was able to present my preliminary results of my doctoral project.

11. Any other comments?

I would like to express my gratitude for providing me this grant to develop my research project and gain ground as a conservation biologist.