Final Project Evaluation Report

Your Details	
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Project Title	Effect of the dispersal of the mistletoe *Bakerella* sp. by frugivorous lemurs on plant communities and biodiversity in eastern rainforest of Madagascar
Application ID	24483-1
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1. 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
How does the overlap in fruiting phenology of host-mistletoe change the composition of frugivorous lemur visitors and are all lemur visitors of infected trees also dispersers of mistletoe?				I have undertaken the following methods to answer this first objective of the project: - We localised all infected trees in the study site and monitored the phenology of trees and the mistletoe (*Bakerella*) every two weeks. During that localisation, very few infected trees were co-fruiting with mistletoe. Moreover, the fruits of these trees were a different type than *Bakerella*. While *Bakerella* has berries, these trees bear dry fruits. - Then, we selected trees bearing more fruits to observe the feeding behaviour of frugivorous lemurs visiting the trees. Among the visitors of the trees, the visitors only removed the fruits of *Bakerella* and did not consume the dry fruits of the trees.
What are the consequences of the lemur visits of infected host trees on the community structure around host species?				In this second objective, the following activities were originally planned: - Use of existing seed traps already set up at regular interval in the study site to count and identify the fruits and/or seeds fallen on the seed traps. I did not carry this activity out for two main reasons. First, very few trees (infected or not) were fruiting in the study area during the season of the fieldwork of this project implying that few seeds are likely to fall in the seed traps. Furthermore, some seed traps were unusable due to their bad state. - Vegetation sampling of vegetation within 5 m around infected trees and also around uninfected trees of the corresponding species to identify the plants to species level. I have fully achieved this activity of this project.

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

Few trees were fruiting in the study site during the fieldwork of this project compared to the previous years (personal observation) may be due to climate change. Among the infected trees that we selected to watch, 12 infected trees in total (only six infected trees per field season) have simultaneously fruited with mistletoe *Bakerella*. Therefore, we identified the visitors visiting the infected trees and recorded their behaviours when consuming mistletoe fruits since the lemur visitors did not consume the fruits of the trees. No shared visitors between the host trees and mistletoe have been observed. This implies that the visitors of the infected trees were potential dispersers of *Bakerella.*

I was not able to conduct the other important point of the project which is the outreach activity concerning the conservation education in schools at the Ranomafana village. The delay of the school year is one of the reasons. The school year all over Madagascar has been delayed about two months than usual (usually, schools start in September). In October, I was already in the field when school started. The problem of insecurity in the region is also another reason. The insecurity was at its highest point few days before the fieldwork ended, schools in Ranomafana were thus closed.

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

To achieve the goal of this project conducted in a primary forest (Valohoaka) and in a forest fragment (Nanetehana) in Ranomafana National Park (21°02' - 21°25'S, 47°18' - 47°37'E), Madagascar, we localised all trees >5 cm DBH infected by the mistletoe *Bakerella* in the study sites and we watched trees infected by fruiting *Bakerella* to observe the feeding behaviour of all frugivore visitors. We performed capturing using Sherman traps and searched feces of lemurs around the watched infected trees to collect seeds from the faeces of nocturnal lemurs for germination tests. We also sampled the vegetation surrounding the infected trees and the uninfected ones of the same species to assess the effect of *Bakerella* infection on community structure and diversity.

a). We watched 31 infected trees belonging to 17 species but 12 trees among them (6 trees per site) were co-fruiting with *Bakerella*;

- During our direct observations, 30 bird species and seven lemur species visited *Bakerella* but seven bird species (mainly the lesser Vasa parrot *Coracopsis nigra* and the Madagascar white-eye *Zosterops maderaspatana*) and 4 lemur species (mainly the brown mouse lemur *Microcebus rufus* and the greater dwarf lemur *Cheirogaleus major*) removed more *Bakerella* fruits.

b). In total, 70 individuals belonging to seven rodent species (in the genus of *Eliurus, Nesomys* and *Rattus*), two tenrecs (genus *Microgale*) and five individuals of *Microcebus rufus* were trapped;

- We collected two seeds of *Dypsis nodifera* in the feces of one of the trapped mouse lemurs but we did not get any *Bakerella* seeds in the feces of trapped *Microcebus rufus.* On the other hand, we collected 29 seeds of *Bakerella clavata* in the feces of *Cheirogaleus major* fallen under one infected tree. We

also manually extracted 41 seeds of *Bakerella clavata* from fruits recently fallen on the ground to compare with the seeds from lemur feces. When performing the germination tests of these seeds in petri dishes, we found that 27 out of 29 *Bakerella* seeds from *Cheirogaleus major* have germinated and their survival was higher within the first seven weeks of planting. However, none of the *Dypsis nodifera* seeds from the feces of trapped mouse lemur and the manually depulped seeds has germinated.

c). We sampled the vegetation around 5 m of 59 infected trees and 41 uninfected ones including in 39 potential species. No results of diversity and community structure are yet available as I am currently managing and analysing the data.

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

Jobs were generated for different categories of local communities involved in this project. Once a week, our field food was transported by porters from the Centre ValBio Research Station to our camp in the forest. These porters come from the villages surrounding the park and they were alternated from village to village during the period of this project. Some of the porters who have never seen lemurs before saw real lemurs (for example the black and white ruffed lemurs *Varecia variegata*) in the forest when they transported the food.

I also employed local guides and cooks who are not permanent workers at Centre ValBio Research Station compared to research technicians. From the training I gave to local guides and technicians, they have learned field techniques on how to conduct research project in the future.

5. Are there any plans to continue this work?

Some questions remain unanswered from this project. These questions will be the objects of new research projects in the same topic.

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

Two months after the end of the first field season, the results of this season have been reported to local authorities in Madagascar such as the Madagascar National Parks and the Malagasy Environment Ministry.

The results of the first field season were also communicated to the graduate students at our Department at the University of Antananarivo to give them an insight of the work I do.

The results of the first field season were already presented at the 56th Annual Meeting of the Association for Tropical Biology and Conservation (ATBC) 2019 held in Antananarivo Madagascar. During the Meeting, many persons have assisted in my presentation and they were interested in the project by asking interesting questions.

The next steps will be the publications of all the results of the project in scientific journals designated to more or less specialised scientists. Besides, I will participate in an event organised by the University of Antananarivo in Madagascar in November 2019 during which the results will be shared to general public and potential funders. I am also using professional social media such as LinkedIn and Research Gate as a mean of result sharing with scientists and potential future collaborators.

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

I started to use the grant from March 2018 until March 2019 to buy field equipment and to cover any costs related to the project. However, the fieldwork lasts 3 months in total divided into two field seasons: October-November 2018 and January-February 2019. The fieldwork was shorter compared to the anticipated project length which should be 12 months: from September 2018 to March 2019 and from September 2019 to March 2020.

8. Budget: 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. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Dry bags	85	20	-65	I only bought one bag instead of four. One was enough to store sensitive materials
Sleeping bags	156	100	-56	I saved £56 because their price in Madagascar was cheaper
Tents	85	103	+18	I added an extra-tent for food storage in the field
Heavy-duty Tarp	76	91	+15	Tarps are very important in remote area experiencing hard climatic season. Therefore, I added two more tarps for shelter
Rain suits	42	86	+44	My rain suit which was first bought in the USA was much more expensive. Then, I decided to buy those of my guides in Madagascar. However, the fabrics of theirs were in lower quality and may be easily to be torn
Rubber boots	38	61	+23	Prices were higher than expected
Backpack	35	35		

Item	Budgeted Amount	Actual Amount	Difference	Comments
Pen, Pencil, Marker	10	5	-5	I did not find waterproof pen. Instead, I used pencil and regular cheap pen to write the data
All weather notebooks	111	92	19	I got the soft cover notebooks which were less expensive
Flagging	11	4	-7	Two rolls of flag were enough for the fieldwork of this project
Laptop	192	252	+60	Actual price was higher than budgeted. The cost has changed between the time of budgeting to the time I ordered it
Compass	34		-34	I did not buy as I borrowed one from my colleague
Measuring tape	25	25		
Diameter tape	31		-31	I did not buy as I borrowed the one of my colleague
Digital camera	108		-108	I did not buy as I borrowed it from our Department
Watch	50	13	-37	I bought only one because the guides got one from other researcher they worked with before
Batteries (AAA, AA, D)	90	18	-72	Fewer batteries were bought because the budgeted battery numbers were computed for 12 months of fieldwork. But, the actual project had shorter period of fieldwork
Flashlight	27	31	+4	
Headlamp	62	150	+88	The model in my budget was not available by the time I bought the headlamps. Instead, this type of headlamp was chosen and it is a higher quality better to use during night walk. Moreover, the tax has contributed to the big difference between the budgeted and actual amounts
Binoculars	116	161	+45	Prices were higher than expected
Handheld GPS	193		193	I did not buy as I borrowed one from my advisor

Item	Budgeted Amount	Actual Amount	Difference	Comments
Station fees at Centre ValBio Research Station	290	112	-178	As the fieldwork was shorter, I stayed at Centre ValBio Research Station was also shorter (two days per month during that period)
Administration fee	570	150	-420	This is a mandatory fee that every researcher pays monthly at Centre ValBio. This fee covers all services related to the research (eg: logistics, errands for buying food ...). But, the food expenses figured in the "Expedition cost" item.
Salary of a CAFF/CORE representative	187	15	-172	The representative person was from the Madagascar National Parks to control the project. He only stayed with us during the first week of the project
Salary of Malagasy technicians	2142	815	-1327	The actual amount was computed from the base salary of the technicians (~£167/person/month). The benefits of each technician when they camp were included in the "Expedition cost" item
Park entrance fee for Malagasy researcher and technicians	30	25	-5	As the fieldwork was shorter, the entrance fee of few months was paid. Moreover, some activities of the project were undertaken in forest fragment outside the park, most of the actual amount was paid to the owner of the land where we camped.
Research permit	125	125		
Transportation to and from the field (including lunch during trip)	66	458	+392	The field equipment was numerous than expected (seven bags in total). Local public transportation did not allow passengers to bring more than two bags per person. Thus, I have to rent a car for transportation to and from the field for the two field seasons of the project. But, there was money saving on the way back to Antananarivo for the second field season because I was able to share a car with other people from the field.

Item	Budgeted Amount	Actual Amount	Difference	Comments
TOTAL	**4587**	**2947**	**-1640**	
Expenses not listed in the initial budget				
Kitchen tools (pot, frying pan, spoon, knife, cup, mug, plate, bowl, vacuum flask, bucket, ...)		123	+123	In this project, which is at its first step, I had not any equipment to use during the camping. It is necessary to buy kitchen materials.
Sleeping mats		24	+24	Mats are necessary equipment to use under sleeping bags
Capturing equipment		80	+80	To reach one of the objectives of this project, I have undertaken additional method. Most of this expense is the Sherman traps rental from a Professor in our Department (~£50) to capture nocturnal lemurs. The remaining covered the cost of materials for monitoring seeds from lemur feces
Communication (credit cards for phone)		5	+5	While in the field, communication with the staff at Centre ValBio Research Station was useful. This communication consists of telephoning them at least once a week primarily for food arrangement
Transportation in the city		30	+30	When doing errands, some materials were heavy and bulky. Therefore, it is necessary to take a cab (Taxi) to transport these materials from the city to home
Bank account fee		28	+28	The monthly bank fee (~£2) was substracted from the Rufford Small Grant

Item	Budgeted Amount	Actual Amount	Difference	Comments
Expedition cost		1778	+1778	The details of this expedition cost include: • Field transportation - Car use for checking the research permit to local authority: 55.5 -Porters of food and equipment: 135 • Cook salary: 110 • Local guide salary: 173.5 • Field food: 929.76 • Prime for technicians (overnight allowance): 229.13 • Weekend work for technicians: 131.82 • Perdiem for technicians and local guide: 10 • Rice bags: 3.13
Not budgeted Total		**2068**	**+2068**	
TOTAL BUDGET	4987	5015	+28	I made a personal contribution to this extra-amount of the actual expense. Exchange rate: £1 = 4,000 Ariary.

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

Designing new research projects are important next steps to address questions that arise from this project. I am planning to apply my proposals for the 2nd Rufford Small Grant. The results of this project provide important basic understanding of the interactions of the mistletoe *Bakerella* and its lemur potential dispersers. But we need to understand if the dispersed seeds reach the appropriate host to survive so that there are continuous interactions between the plant and lemur species. Also, we need to understand if the presence of *Bakerella* helps in maintaining the diversity of the community around host trees and thus enhancing forest regeneration by monitoring the survival of seedlings around host trees. The conservation education of children around the Ranomafana National Park is also my next priority as I was not able to conduct it during this project.

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

As mentioned in question number 6, I presented an oral presentation of some results of this project at the 56th Annual Meeting of the Association for Tropical Biology and Conservation 2019. I also presented the results of the project to the graduate students at our Department at the University of Antananarivo. The Rufford Foundation logo figured in my last slide of those oral presentations.

Other scientist colleagues were interested in applying to Rufford Grant as the Rufford Small Grant I got has attracted their attention. Also, during the Workshop organised the day following the ATBC Conference Rufford grantees were given a priority in participating in that Workshop.

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

My team who primarily participated in this project was composed five people. Two are field research technicians, two local guides and one cook. The technician names are **Jean Claude Ramanandraibe** and **Nerée Beson**. Local guides are **Hoby Randriamahavonjy** and **Jacquob Razafindrato**. The cook is named **Paulette Mialintsoa**.

Research technicians and local guides assisted me in all field activities including data collection and capture of animals. The cook was involved in the kitchen activities.

In addition to the field team, the research management and logistical support team at the **Centre ValBio** helped in checking my research permit to local authorities and in managing our field food.

12. Any other comments?

Receiving and managing Rufford Small Grant is a great and joyful experience for me.