Final Evaluation Report

Your Details	
Full Name	Hasinala Ramangason
Project Title	Spatio-Temporal Variation in Fruit Supply in a Highly Fragmented Landscape: Response of Frugivorous Lemurs
Application ID	32602-1
Date of this Report	August 22 2022

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
Evaluate occupancy of frugivorous lemurs in a highly fragmented landscape. This will be achieved through intensive camera trapping, using both arboreal and ground camera traps.				Some changes were made to the data collection protocol after discussing with other researchers working on the three study species. They argued that while the camera trapping method would help investigate lemur occupancy in response to fruit availability, it is not the strongest proxy to investigate interaction between frugivorous lemurs and fruiting trees. Instead, they suggested that daily lemur follows would be more accurate to survey feeding behaviour of lemurs. We therefore switched to this method and simultaneously monitored the feeding behaviour of the three species daily. In total we sampled over 3000 feeding bouts for the three species and recorded the spatial location of lemurs every 15 min, allowing us to understand how they move through their habitat in search for their foodplants.
Map resource abundance and diversity in multiple plots. Botanical plots will be surveyed around each camera trapping point. Results from these surveys will be linked to the results of the lemur occupancy in a spatially explicit model				We mapped resource abundance using two methods. First, we assessed resource abundance at the habitat level through transects that we surveyed every 2 weeks, covering a total area of 1 ha. The second method consists of surveying fruit availability at a smaller scale (10 x 10 m plots), around each feeding tree. By combining both methods, we were able to survey how fruit availability at the neighbourhood vs. habitat level affects fruit selection and identify keystone foodplants in their diet.
Assess the effectiveness of an ongoing reforestation				Because we moved to Ranomafana after the cyclone hit Kianjavato, we

program for promoting lemur diversity and inform conservation efforts and management practices.				were no longer able to achieve this objective. Instead, we set up a new objective with a strong conservation value which is to assess the devastating effects of the cyclone on the availability of fruits, and subsequently inducing nutritional stress in the study species. After analysing the data, we found striking evidence that although Ranomafana sustained less damage compared to Kianjavato, the spatio-temporal availability of fruit in Ranomafana significantly dropped after the cyclone, which impacted the dietary diversity of the study species.

2. Describe the three most important outcomes of your project.

a). Fruit availability was significantly altered by the cyclone. Fruiting diversity and intensity was severely low in March. Although fruiting later increased in April, it did not peak during this month, which is expected to be the month of peak fruiting intensity. Instead, fruit availability kept increasing in May and plateaued in June.

b). The three study species have different responses to fluctuating fruit availability in their habitat. When fruit availability drops, *Varecia variegata* significantly travels less and focuses on a subset of fruit species (e.g., palm trees) which are not necessarily the most nutrient rich fruits; and complements its diet with leaves. *Eulemur rubriventer* adopts a similar strategy, although it complements its diet with a greater proportion of leaves. *Eulemur rufifrons* significantly alters its home range when fruit availability in its original range drops.

c). The study species will be undergoing an extended fruit lean season this year, therefore a higher nutritional stress. We were able to analyse data for *Varecia variegata* and found unexpected results. As fruit availability increased, transitioning from March to April, this species subsequently increased the diversity of consumed fruit species. However, as fruit availability kept increasing through May and June, their diet breadth was significantly compressed during those months, indicating that they physiologically switched to the lean season where they travel less, and spend more time resting and complement their diet with leaves. Therefore, the cyclone induced a mismatch between fruit availability in the habitat and diet diversity of this species and an extended period of nutritional stress.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

The unexpected cyclone was the major factor that disrupted many aspects of the project. First, we had to move to Ranomafana to be able to work in safe conditions after Kianjavato was severely hit by the cyclone. Second, although Ranomafana

sustained less damage, we had very few fruiting trees during a period where fruiting is expected to peak. This resulted in lemurs being more difficult to find as they had to adjust their movement patterns to areas where they could find fruiting trees. To overcome this, we had to travel longer distances daily to find lemurs groups.

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

I worked with a total of six local technicians, three of whom were highly skilled (over 15 years of experiences) and three junior technicians (1 year experience). First, we were able to provide substantial training to the junior technicians, as they were trained to a range of data collecting techniques ranging from behavioural and phenological sampling to spatial data recording. Further, the more experienced technicians also trained the junior ones to plant identification so they could expand their repertoire. They were also trained to techniques of finding and tracking lemurs in the wild. This aspect is central for the continuity and transfer of traditional knowledge of plants and animals from a generation to another.

Altogether, this experience will further qualify the junior technicians to join future research and conservation projects that are implemented in the Ranomafana area. By hiring local technicians and local porters, we were also able to provide alternative source of income to local communities (technicians employed daily, and porters employed twice a month for material and food transportation). The Ranomafana area is hotspot for conservation projects and tourism. COVID-19 has put a halt on several projects as well as the tourism industry, and such economic stress on local communities is known to result in increased pressure on natural habitats in Madagascar. Although we were only able to hire a limited number of local technicians and porters, working with these communities allowed to provide a temporary financial relief to a few households.

5. Are there any plans to continue this work?

This work is a part of my PhD and is directly tied to future projects that will be carried out towards the fulfilment of my degree. I have already developed a project that is in continuity with the current project.

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

Results will be shared through scientific communications (written, and oral) in journals and conferences, as well as in my department at the University of Calgary. I will also submit a technical report to Valbio which will be shared with Madagascar National Parks.

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

Extend the analysis to *Eulemur rufifrons* and *Eulemur rubriventer* to have a complete overview of how the three species respond to fluctuating fruit availability after the cyclone. Further, because of the extended nutritional stress these species are undergoing in the aftermath of the cyclone, we have identified a vastly unexplored

aspect of the conservation physiology of these species. We will write up a grant application to investigate this and submit it to Rufford Foundation for a 2nd Rufford Small Grant.

8. 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?

The analysis on *Varecia variegata* has already been shared through a poster presentation at the Ecological Society of America and Canadian Society of Ecology and Evolution joint meeting in August 2022 and I used the Rufford's Foundation logo.

9. Provide a full list of all the members of your team and their role in the project.

Andry Ny Aina Ary Misa: Master's student from the University of Antananarivo in plant biology. As a plant biologist, she assisted me in the curation of data from botanical surveys. She also assisted me in coordinating the logistical aspect of the project.

Mihajatiana Tanjona: Master's student from the University of Antananarivo. As an animal biologist, he led data collection on Eulemur rufifrons and is currently in the process of writing his thesis from data collected in the field.

Theudy Alexis: Master's student from the University of Antananarivo. As an animal biologist, he led data collection on Varecia variegata and is currently in the process of writing his thesis from data collected in the field.

Dada Guy, Albert, Victor, Solofo, Tsiferana, Toky: These were local technicians that worked with us during expeditions. They are all experienced in finding and tracking lemurs, as well as plant identification.

Herizo, Tolotra: They were the cooks during our expeditions and managed the supply of food and water during our expeditions.

10. Any other comments?