Final Evaluation Report

Your Details	
Full Name	Meredith Semel
Project Title	A Division of the Crown: using novel tracking collars to examine behavioral and physiological responses to fragmentation in golden-crowned sifakas
Application ID	33782-D
Date of this Report	12 October 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
1) Identify differences in movement and foraging patterns between golden-crowned sifaka groups across their global range				After months of continuous data collection, we were able to gather movement and foraging data from six sifaka groups over a 4-year period (2018-early 2022). A manuscript of our findings was recently published in *Movement Ecology* (attached)
2) Determine differences in stress hormone (faecal cortisol metabolite) levels between different groups of lemurs				Between March-July 2021 I analysed over 800 faecal samples to quantify faecal glucocorticoid metabolite levels. I am still completing the final statistical analysis and will submit the manuscript to the journal *Conservation Physiology*.
3) Initiate a long-term, community driven environmental outreach program				Over the past 18 months, a primary focus of our work has been environmental education and sustainability in the region. We have a full-time (year-round) programme that works with nearly 500 primary and secondary students on a bi-weekly basis.
4) Collaborate with a team of social scientists, anthropologists, and human dimension (of conservation) experts to design and apply a comprehensive survey and focus group study to quantitatively assess the benefits (and weaknesses) of our outreach program				After nearly 1 year of drafting a survey and interview script, we are working with students to conduct pre- and post-assessments. Within the first month of joining the outreach programme, students participated in a voluntary survey. The same procedure will be used after 1 year of enrolment to quantify the benefits (and flaws) of the programme. Specifically, it will help us to determine if the outreach has led to behavioural changes in the community.
5) Collaborate with Malagasy NGO and community members to spearhead several entrepreneurial				Between January-April 2022 sap was harvested from *C. velutinifolium* trees (locally referred to as haramy) within the Binara forest fragment. We worked with the local KMTs to select

programs				the most appropriate haramy trees and a portion of the raw extracted resin was sold in the weekly Daraina market (for local individuals to use as a sustainable fire starter, sealant, or varnish). The proceeds of the market sale have gone directly into per diem salary for all KMTs involved and the remainder of funds went back into the outreach centre. We have also continued to raise chickens in the community.
6) Initiate a sustainable (conservation) agriculture program for students and local community members				We have partnered with NGO Madagasikara Voakajy to work towards more efficient farming practices in the region that reduce the need for slash and burn agriculture. This programme involves hands on experience and classroom curriculum concerning rainwater harvesting, increasing soil fertility/moisture, erosion control, crop rotation, and land-use selection.

*Note: Some objectives are still listed as partially achieved because this work will continue. Future field seasons will allow us the additional time needed to fully achieve these objectives and continue our conservation education efforts in the region.

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

a). One of the most important outcomes of this field season was being able to work with 532 primary and secondary students in Daraina between February 2021-August 2022. The fully constructed Fanilo "Lantern" Centre (pictured to the left) has been a pivotal feature in the community allowing students a central space to gather. In addition to the daily outreach programmes that took place, the outreach centre houses a library that is open to the public every Wednesday morning, Friday afternoon, and Sunday morning. We received a very generous donation of Malagasy and English science/nature books that are regularly used by community members.

Part of the Fanilo Centre curriculum has also been focused on public and reproductive health. While we cannot guarantee that our programmes are the direct cause, Daraina has been a significant drop in teenage pregnancies over the past 1.5 years (since the initiation of regular educational programming).

b). A second important outcome was being able to hire local guide Amidou as the full-time outreach coordinator (pictured below to the right) for the Fanilo Centre and Julie Ratovoson as the full-time outreach director. Prior to this field season, educational programmes occurred during breaks from sifaka field data collection. Having two full-time Malagasy staff members has allowed the Fanilo Centre to function on a year-round continuous basis and for sifaka population monitoring to occur simultaneously. Having local Malagasy individuals as staff has also fostered cultural identity and empowered the community in decision-making processes concerning land-use changes (specifically, in reducing deforestation). Local community members have continually expressed their gratefulness for the reliability and accessibility of our educational efforts.

One of Amidou's main focuses has been working with parents and guides to bring groups of students into the Bekaraoka forest fragment to observe Malagasy wildlife and plants (pictured to the left). Amidou has been able to lead overnight camping trips for nearly 250 students over the past year! This has allowed students to learn valuable knowledge and skills in the classroom, but also experience the benefits of conservation in a hands-on atmosphere. Students have practised field methods (lemur behaviour collection, plant identification, etc.) and this has been the first time many of these students have ventured into the forest.

c). Thirdly, at the request of the guide association, we have also initiated two entrepreneurial projects (with a third beginning soon). These programmes include a chicken coop project and tree sap harvesting project. Fanamby, our partner NGO, has worked to help communities cultivate high value resources such as vanilla, spices, essential oils, and fish, however, these goods are difficult to produce across the Loky-Manambato protected area due to the arid climate. Chickens and eggs are very expensive in the region (three to five times more expensive than those in the capital region) due to a lack of proper avian vaccination and coops. Thus, our community-led programme has been breeding chickens in order to use eggs as a sustainable income for off-duty guides and to provide an alternative to bushmeat hunting. These eggs are being sold at the weekly Daraina market and proceeds are used to pay employee salaries and to purchase outreach supplies.

Similarly, we started tapping into haramy trees this past rainy season (January-April 2022). We have been able to successfully (and sustainably) harvest resin in a manner that is not detrimental to these impressive trees, while is enabling us to collect a valuable natural resource which provides an alternative to charcoal production.

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

Cost of goods (outreach supplies, food, etc.) and transport within the region rose drastically over the year this work was conducted. Additionally, the rainy seasons (February 2021-April 2021 and January 2022-April 2022) experienced higher than average rainfall. As a result, many days in Daraina were overcast and our solar panels were not able to produce the energy needed to print activities and run our projector. As a result, many outreach activities had to be postponed. We were able to tackle these issues by using proceeds from egg and resin sales to purchase more efficient solar panels (and battery). Additionally, due in part to the intense rainy season, the Fanilo Centre also struggled with infrastructure damage (specifically, roof damage). This led to our printer experiencing water damage and needing to purchase another.

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

I continued to work closely with Fanamby, the Daraina guide association, and the local schools during my 2020-2022 field seasons. Fanamby is an NGO in northern Madagascar that seeks to better understand how biological, social, and economic factors influence threatened ecosystems and how integration of these ideals can lead to successful regional conservation plans. By working with Fanamby to complete my research and build and run the Fanilo centre, we fostered community/stakeholder engagement and accountability to help Fanamby effectively accomplish their goals as an NGO. It is my goal to continue to work closely with Fanamby to develop strategies to protect Daraina's lemurs and their habitat.

During this field season I also continued to work closely with Amidou Souleimany, the head guide of the Daraina Guide Association (managed by NGO Fanamby) and Fanilo Centre educational coordinator. In addition to his research-based skills of coordinating the guide hiring and training process, Amidou is the president of Daraina's private primary school, and his help is vital in organizing outreach plans and implementing our outreach programme. He has an excellent rapport within the community and is highly respected as a guide, administrator, and community leader. With Amidou's knowledge of Daraina's educational structure and curriculum, we have been able to form relationships with teachers in the secondary and primary schools in Daraina and will be able to arrange field trips and educational programmes in a way that benefits the students most effectively.

This project also benefited the local community by employing 34 guides throughout the field season (for lemur follows and guide training) and an additional ~30 community members as porters. All food was purchased from local shops in Daraina and bought locally grown beans, rice, potatoes, corn, and fresh fruit whenever possible. We have also initiated a community garden at the Fanilo Centre that has provided valuable produce including fresh greens and carrots.

The Fanilo Centre, which has been designed to meet the needs specified by individuals in the Daraina community, is continually seeking to improve sanitation, food sustainability, and access to electricity in Daraina. Providing education and training in how to produce food more sustainably will increase intrinsic value of the habitats and lead to more effective resource management. Our hope is that the Fanilo Centre will lead to continued infrastructure development, behavioural change of local communities, employment opportunities for people in the community, and increased emphases on public health.

5. Are there any plans to continue this work?

I have recently (late April 2022) defended my PhD and begun work at the University of Minnesota, Morris. While I will no longer be completing this week as a graduate student, I am still very involved in the day-to-day workings of the Fanilo Centre and golden-crowned sifaka population monitoring. With the help of local individuals in Daraina, I plan to continue monitoring the sifaka population on a long-term basis (to

gain a better idea of the long-term forecast of the species) and working with my team to further improve the Fanilo Centre educational and entrepreneurial programs.

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

As part of my dissertation, the results of this work have been published in Movement Ecology and International Journal of Primatology (both articles attached). The hormonal based side of the study will be submitted to Conservation Physiology in the coming months. I will also continue sharing my results on Wild Labs and Conservation X Labs, specifically to help other conservationists apply tracking technology and hormonal quantification to their studies of threatened and endangered wildlife.

I will continue improving the Fanilo Centre. By helping expose Malagasy children to the wildlife surrounding them, we hope to connect them with nature in a way that compels them to be stewards of the environment and advocates of sustainability practices in their homes and local communities. Overall, being able to effectively connect my science to local individuals will also aid in stronger communication pathways between grassroots communities all the way up to local authorities.

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

The immediate next steps for my project include further in-depth analyses of the collected hormonal data. By understanding the impact of habitat type on sifaka physiological responses, we can understand the impacts of land management practices. We can also understand how measures of chronic physiological stress differs across various habitats and degrees of fragmentation.

Second, a vital step of this project is to continue conducting community interviews and surveys to access the efficacy of the Fanilo Centre educational programme. Additionally, community members have expressed an interest in becoming involved in other entrepreneurial objectives. Thus, we are hoping to start an apiary to sustainably produce honey (because the current process of obtaining honey in the region involves cutting down trees in which hives are found). We hope these maintainable programmes will help provide local individuals with jobs that are alternatives to gold mining, charcoal production, or logging.

Now that the paved road running through the golden-crowned sifaka range is fully completed, we hope to continue data collection to access the impact the road has on sifaka behaviour and physiology.

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?

Yes, the Rufford Foundation logo was featured during my public dissertation defence (April 2022) and at the Interfaces of Global Change conference (USA, April 2022). The Rufford Foundation was also given credit in both peer-reviewed publications.

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

Julie Ratovoson: Malagasy Field Technician and Outreach Director
This field season, along with my previous field season, would not have been possible without Julie! She assisted in every stage of data collection from lemur habituation to vegetation sampling, faecal sample collection, and full day behavioural follows. She also provided important intellectual contributions and was a great asset to the project. She was also the driving force in combating issues regarding the construction if the Fanilo Centre and in planning many of the lesson plans and activities that were used in the community.

Local guides from Daraina:
Over the course of the field season, I was able to hire over thirty local guides from the Daraina guide association. The local guides have impressive knowledge of the terrain and hiking trails in the region, have superior tree species identification skills, and familiarity with the lemurs and other wildlife species. Julie and I trained all guides on our protocols for collecting lemur behavioural data, faecal samples, and vegetation sampling. I was again able to hire the head of the Daraina guide association, **Amidou Souleimany**, for the entire field season. In addition to coordinating the guide hiring and training process, Amidou served as the full-time outreach coordinator and was able to help organize ALL outreach plans and camping trips.

Ignacio Moore
Dr. Moore was my academic advisor at Virginia Tech and Professor of Biological Sciences. As a behavioural endocrinologist, he was particularly beneficial in helping run the hormonal analysis and continues to be an asset as I analyse these results.

MICET, NGO in Antananarivo
Although MICET did not directly assist with logistics once I was in Daraina, they provided assistance with applying for a long-term research visa, government export permits for biological samples, transportation to Daraina, and connecting me with Julie, my Malagasy graduate research assistant.

Fanamby, local NGO
Although Fanamby staff were not directly involved in data collection, their assistance with vehicle rentals, hiring of local guides, and overall logistics was invaluable. **Dr. Serge Rajaobelina** (Founder of Fanamby) and **Tiana Andriamanana** (Executive Director of Fanamby) were essential resources and provided knowledge about the golden-crowned sifakas, their habitats, and conservation management plans in Daraina. As the director of Fanamby, Tiana was able to help my field team orchestrate various field season logistics and will also assist with the success implementation and running of the Fanilo Centre.

10. Any other comments?

I am incredibly appreciative for The Rufford Foundation's substantial contribution to my project for the past 5 years! This funding has enabled me to equip a strong field

team of local Malagasy researchers and guides and this project would not have advanced nearly as far without The Rufford Foundation. This fourth round of funding enabled a full year of environmental education in Daraina and many days of monitoring sifaka groups in the region.