The Rufford Foundation
Final Report

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

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. 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. Please note that the information may be edited for clarity. 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	Ricardo Faustino de Lima
Project title	The Role of Bird Seed Dispersal on São Tomé Forest Dynamics
RSG reference	18618-B
Reporting period	December 2015 to May 2017
Amount of grant	£9162
Your email address	rfaustinol@gmail.com
Date of this report	13th June 2017

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
Provide a better understanding of the threat posed by introduced species to the long-term conservation of São Tomé's endemic-rich biodiversity.			■	Since endemic birds are spreading exotic plants their expansion will be difficult to contain and represents a significant long-term threat to São Tomé forests.
Understand how bird seed dispersal might be affecting the regeneration of native forests.		■		Since seed viability is difficult to assess, we cannot be sure about which interactions represent actual seed dispersal events.
Understand how bird seed dispersal might be affecting the spread of exotic plant species.			■	We have confirmed that birds transport viable seeds of exotic plants, namely in the obô.
Build in-country capacity for bird mistnetting.			■	We increased the number of people working with mistnetting and other Santomeans regularly assisted with mistnetting.
Build in-country capacity for seed identification.		■		Identifying seeds is challenging, so to better fulfil this goal a specific training session should have been included.
Build a seed reference database.			■	The seed reference collection is a work in progress, but we managed to obtain over 500 sampled from around 300 species, plus over 30 unidentified seeds collected in bird faeces.
Start defining a strategy to minimize the long-term impact of introduced species.		■		Although we provided important information on seed dispersal for São Tomé, data is still limited and might be too short to properly inform decision makers. To overcome this difficulty, we now have an MSc student working on mammal seed dispersal, and trying to identify knowledge gaps on

				vertebrate seed dispersal in São Tomé, to guide future research and conservation activities.
Translating and getting this message to the relevant stakeholders.				We are still processing data, so could only provide preliminary conclusions. However, we are in touch with the stakeholders and will provide them feedback once our analyses are finished.

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

The most significant change we had to make, to overcome an unidentified difficulty had to do with the safety of the mist-netted birds. To guarantee it, we had to start sampling trimestrally instead of monthly, so that an experienced ringer was always supporting fieldwork, and had to visit the nets every 30 minutes, which meant more people were needed in the field at any given time. For logistic reasons this study was confined to montane forest, and other habitats were only sampled sporadically.

We cannot guarantee that all the seeds obtained from the birds are viable, and were not successful at conducting germination tests, as these are difficult to perform, namely due to high rates of fungal infections.

Identifying seeds was much harder than what we had envisioned, so the proportion of seeds identified is lower than what we had expected. Nevertheless, we still hope to identify more seeds, after expanding the seed reference collection to include seeds that were obtained in the Coimbra (COI) and Lisboa IICT (LISC) herbaria.

We could not provide the São Tomé and LISC herbaria with seed reference collections, as both are currently not accepting new material, as both were being moved. We are in touch with them, and will provide them with a collection once they start receiving new material again. Alternatively, we might leave the seed reference collection at COI, since they also collaborated with our work, have a better capacity to deal with this sort of material and currently have a project to support recovering São Tomé's herbarium. Anyway, we have photographed all seeds in the collection in high quality and will make them available in a virtual seed reference collection.

Finally, since we are still processing data and there are still major knowledge gaps in São Tomé forest seed dispersal, we could not provide solid evidence to support any strategy. To overcome this difficulty, we have an MSc student working on identifying knowledge gaps concerning vertebrate seed dispersal in São Tomé. We have nevertheless passed preliminary information to the relevant stakeholders and will continue to do so when further information becomes available.

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

The key outcomes of this project were the creation of the first seed collection for São Tomé, an improved knowledge of bird seed dispersal, and capacity building.

The seed reference collection was key to support this work, but will also be made available for future work taking place in the island.

Our knowledge on bird seed dispersal in São Tomé forests was greatly improved thanks to this project. Between March 2016 and February 2017, we captured 1946 birds belonging to 18 species during the systematic surveys. 95.5% of these belong to 14 endemic species (out of a total of 20 Gulf of Guinea endemic bird species occurring in São Tomé). Additional sampling allowed capturing 1947 more birds (90.1% endemic), including 10 new species (three of which endemic – Table 1).

Having just over 10% of the systematic samples and around 150 of the supplementary left to process, we have confirmed almost 1200 interactions in nearly 600 droppings. These involve 89 seed morphotypes and 10 bird species. Over 30 seed morphotypes have already been associated with a plant species, including most common species. This work is nevertheless still ongoing.

These preliminary analyses suggest that only a relatively small proportion of the bird community is involved in seed dispersal, and that this ecosystem function is dominated by one bird species; The São Tomé speirops *Zosterops lugubris* represents almost two thirds of the dispersal events, is the most abundant species, almost all individuals provided faecal samples containing seeds and each faecal sample often contained multiple seed species. No other bird species seems to disperse near as much as the speirops, but they might still play key roles in seed dispersal, namely by dispersing additional species, at longer distances or to better locations.

Preliminary results confirm that bird seed dispersal is reliant on endemic birds, and that some endemic plant species might be dispersed by birds. However, they also suggest that endemic plant seeds are far less frequently dispersed by birds than introduced plant seeds. Worryingly, among the most frequent introduced plant species seeds being dispersed are the trumpet tree *Cecropia peltata*, the roseleaf bramble *Rubus rosifolius*, the common guava *Psidium guajava* and other species known to be highly invasive in other tropical regions. This suggests that bird might be important to maintain some endemic plant species, while at the same time promoting forest invasion by introduced species. A conflicting dual role, which will be difficult to overcome when considering long-term forest conservation.

Finally, this project contributed to local capacity building, namely regarding bird mistnetting and plant identification. During fieldwork, we employed four Santomeans: three to help mistnetting and another one to help sampling plants (fruits, seeds and seedlings). Of the three helping with the mistnetting, two had little previous experience. The person helping with plant identification is a local parabotanist, which is probably the most experienced person identifying São Tomé plant species in the field, but that had limited experience identifying fruits and seeds.

Additionally, there were other people, who voluntarily joined the ringing sessions, both Santomean and foreigners.

Table 1 – Birds mistnetted during this project. All birds were marked using SAFRING rings (http://safring.adu.org.za/), measured and subsequently released. In the "endemic" column, S means São Tomé, P Príncipe, A Annobón * endemic subspecies, ** endemic subspecies sometimes considered endemic species, and *** São Tomé endemic subspecies.

Common name	Scientific name	Endemic	Systematic	Additional	Total
Red-headed lovebird	*Agapornis pullarius*	No	0	4	4
São Tomé sunbird	*Anabathmis newtonii*	Yes (S)	171	187	358
African emerald cuckoo	*Chrysococcyx cupreus*	No*	1	3	4
Lemon dove	*Columba larvata*	No**	69	43	112
Island bronze-naped pigeon	*Columba malherbii*	Yes (SPA)	0	4	4
Maroon pigeon	*Columba thomensis*	Yes (S)	0	1	1
Malachite kingfisher	*Corythornis cristata*	No*	0	3	3
Príncipe seedeater	*Crithagra rufobrunnea*	Yes (SP) ***	94	159	253
Giant sunbird	*Dreptes thomensis*	Yes (S)	43	25	68
Common waxbill	*Estrilda astrild*	No	17	114	131
White-winged widowbird	*Euplectes albonotatus*	No	0	1	1
Bronze manikin	*Lonchura cucullata*	No	1	3	4
São Tomé shorttail	*Motacilla bocagei*	Yes (S)	0	1	1
Chestnut-winged starling	*Onychognathus fulgidus*	No**	0	11	11
São Tomé oriole	*Oriolus crassirostris*	Yes (S)	7	19	26
São Tomé scops owl	*Otus hartlaubi*	Yes (S)	5	4	9
Giant weaver	*Ploceus grandis*	Yes (S)	13	59	72
São Tomé weaver	*Ploceus sanctithomae*	Yes (S)	75	149	224
Southern masked weaver	*Ploceus velatus*	No*	0	2	2
São Tomé prinia	*Prinia molleri*	Yes (S)	109	116	225
Laughing dove	*Streptopelia senegalensis*	No	0	4	4
São Tomé paradise	*Terpsiphone atrochalybeia*	Yes (S)	186	171	357

flycatcher					
São Tomé green pigeon	*Treron sanctithomae*	Yes (S)	6	1	7
São Tomé thrush	*Turdus olivaceofuscus*	Yes (S)	388	280	668
Blue waxbill	*Uraeginthus angolensis*	No	0	5	5
São Tomé spinetail	*Zoonavena thomensis*	Yes (SP)	2	9	11
São Tomé white-eye	*Zosterops feae*	Yes (S)	10	68	78
São Tomé speirops	*Zosterops lugubris*	Yes (S)	749	501	1250
Total Geral	**Total Geral**		**1946**	**1947**	**3893**

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

We did not foresee a major engagement of local communities in this project. However, we have been in contact with relevant local institutions and provided temporary jobs for four inhabitants of local communities during the project.

5. Are there any plans to continue this work?

Yes, I am applying for funding to continue and expand this work. In the meantime, several activities resulting from this project are still ongoing, namely increasing the seed reference collection, processing the faecal samples, seed identification, and data analyses. Subsequently we will use these data to support two scientific articles and a final report to be delivered to local stakeholders and support future research and conservation regarding this topic

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

Preliminary results have been presented at the 2nd International Conference on Island Evolution, Ecology and Conservation (July 2016, Azores, Portugal), were the basis for Ana Coelho's MSc thesis and were summarised in a report for local stakeholder, in Portuguese (all attached to this report). An additional MSc student, Filipa Mendes, based at Coimbra University is finishing her thesis, which will compile information on seed dispersal for the island and identify knowledge gaps for future research.

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

The grant was used between March 2016 and March 2017, while the initial predicted duration was between December 2015 and December 2016. However, the full length of the project has been extended by having the two MSc students involved, so it can be considered that it started in September 2015 and will continue until the end of 2017, when we hope to submit the data for publication in a scientific journal. If further funding is ensured, this grant would have worked as a pilot for an extensive study on this topic in São Tomé.

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
International flights	2847	3538	691	An extra flight was booked so I could be present in all mistnetting sessions
Local transportation	949	265	-684	To open the mistnets as early as possible we had to camp near the sites, therefore greatly reducing the anticipated costs. We also quit sampling in lowland forest to stay in budget.
Accommodation	730	691	-39	
Field assistants	3066	3446	380	I hired an extra field assistant to ensure the security of birds during mistnetting.
Communication	438	140	-298	This was greatly reduced because I ended up always being in the field.
Equipment	986	1025	39	
Workshop	146	73	-73	These expenses were greatly reduced, since we still only have preliminary results. An additional effort will be made to communicate final results, once these are available.
TOTAL	**9162**	**9176**	**-14**	

The Santomean dobra is the local currency, but larger payments are often done in euros, to which there is a fixed exchange rate (1€ = 14 500 STD). We used a fix exchange rate of 0.73 to convert euros to sterling pounds.

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

In terms of research it is key to identify knowledge gaps to define future research priorities, which is what we aim to obtain from Filipa Mendes' thesis. It is nevertheless clear we need to know more about seed viability, plant recruitment, invertebrate seed dispersal and other habitats, besides montane forest.

In more practical terms, it is key to translate these results into management suggestions and to communicate these with relevant stakeholders, which is something we intend doing once we manage to digest the data and results we have.

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

Yes, the logo was used in all presentations resulting from this project (Azores, Ana's thesis, local workshop) and in the Portuguese report to the local authorities. All publications resulting from this project (Ana's MSc thesis, report to local stakeholders) have acknowledged Rufford's funding, and will continue to do so (Filipa's MSc thesis, scientific publications), whenever possible. We have also mentioned funding when contacting the media (CNN - http://edition.cnn.com/videos/world/2016/11/07/inside-africa-sao-tome-and-principe-biosphere-c.cnn, local TV), but unfortunately this mention never makes the final edit.

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

Ricardo Lima supervised the project, including all field activities. Ruben Heleno provided the expertise on seed dispersal and ecological networks, and have co-supervised the MSc students. Ana Coelho conducted a pilot survey, analysed preliminary data and did most of the laboratory work (sample processing, seed identification). Estevão Soares was responsible for plant identification, collecting seeds for the seed reference collection, and sampling forest recruitment and fruit availability. Sidiney Samba, Octávio Veiga and Leonel Viegas supported mistnetting, bird processing and faecal sample collection.

In the field, we were occasionally assisted by Dr. Aimy Cáceres, Dra. Ursula Franke, Thomas Bryson, Carlos Pacheco, Bárbara Madeira, Filipa Mendes, Filipa Soares, Gabriel Oquiongo and Gegé Lima. Martim Melo collected additional samples. Jorge Palmeirim co-supervised Ana Coelho and provided overall advice on data analysis. Filipa Mendes helped processing some of the bird faecal samples and will also use the data obtained in this project to write her MSc thesis.

12. Any other comments?

No.