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	Spencer Christian Schubert
Project title	Measuring the Role of Birds in Accelerating Forest Restoration and the Stability of Seed Dispersal Mutualisms in Disturbed Landscapes of the Dominican Republic
RSG reference	25432-B
Reporting period	June 2018 – May 2019
Amount of grant	£10,000
Your email address	sschu001@odu.edu
Date of this report	24 June 2019

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
Continued Monitoring of RSG I Studies			■	We have continued our monitoring of experimental abandoned pasture plots to study the influence of birds in forest succession. In May 2018 and May 2019, we have conducted follow-up surveys of plant regeneration. This data, together with work done in prior years, is now being drafted as a manuscript for publication.
Expanding Restoration Projects		■		We managed to build only one of three originally targeted restoration sites. However, we are currently working with Rancho Baiguate to build a large restoration plot along a deforested section of the Baiguate River on their property.
Bird and Plant Surveys (Phenology)			■	Completed as planned.
Foraging Observations			■	Completed as planned.
Seed Collections and Molecular Analysis		■		The field work has been completed as planned. Laboratory work is still pending. Two additional research grants have been secured to complete this component.
Disseminating Progress and Results			■	While not all presentations and speaking engagements that I anticipated came to pass, other similar opportunities were pursued.
Conservation Side Projects			■	We installed four nest boxes for endangered golden swallows on a private property in La Ciénaga that is in the process of gaining recognition of a federally protected wildlife sanctuary. As of yet, we have not confirmed use of these nest boxes by the target species. In addition to the work in this area, my project has helped support pilot studies on several other sites that have now been registered as MoSI bird banding (aka ringing) sites by the Institute for Bird Populations. We hope to pursue long-term bird population monitoring through

				Verde Soy Foundation with the support of our local and international partners.
Outreach, Collaboration, and Training				We led several activities with community members and other groups and partners to promote environmental education and ecotourism. The major involvement included leading a youth "birding club" for the local summer camp at Rancho Baiguate, in which children learned to identify and appreciate birds and build and observe bird feeders, among other activities. We led a day-long field course for ISA university students to teach introductory bird survey methods. And we organised the first ever Christmas Bird Count in Jarabacoa that involved more than 20 students and nature enthusiasts from the community.

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

Over this past year, my project operated remarkably smoothly when compared to previous years and was largely free of major problems or setbacks.

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

1. Surveys & Plant-frugivore Network Data

The study that began during the 2nd year of the project and expanded thanks to the Booster Grant represents a remarkable scientific accomplishment. Over a 12-month period, we recorded more than 37,000 detections of birds of 76 species at our six monitoring sites as well as flower and fruit phenology data from 65 species of forest plants. Based on more than 2,000 follow-up focal observations of plants with ripe fruits, we documented a network consisting of 42 bird species and 54 plant species. Based on initial analyses of this data set, we have been able to identify both bird and plant taxa that have a disproportionate influence over frugivory and seed dispersal processes. As anticipated, the palmchat was by far the most active frugivore in the study region. Several other species – all year-round residents – that also featured prominently included the Hispaniolan woodpecker, black-crowned palm tanager, black-whiskered vireo, and red-legged thrush. Our study also identified a number of avian seed dispersers that were not previously known to feed on fruits, including both species of tody (*Todus* spp.). Regarding plants, numerous species were identified as important food resources for birds, but these varied widely depending both on locality and the time of the year. Species with the greatest role in the plant-frugivore network included those that have relatively small seeds and extended periods of ripe fruit availability (e.g. year-round flower and fruit production) such as *Trema micrantha*, *Zanthoxylum elephantiasis*, and *Casearia guianensis*. Such fruits were consumed by nearly all frugivorous bird species.

There are many previous works that have described and analysed seed dispersal mutualisms between frugivorous animals and plants. However, there are exceedingly few such studies that have achieved spatial and temporal replication in this type of data collection, with most of these studies limited to a single site or within a confined season. The data from this project, by contrast, represents both a broad geographic region and the full annual phenology of a tropical forest ecosystem. Using this data, I will be able to contribute broadly to ecological theory by deriving the statistical properties of plant-frugivore networks and examine these across different spatial and temporal scales to understand how 'sampling completeness' may influence or bias the interpretation of these networks and the prevailing hypotheses concerning how biodiversity affects the stability of these communities.

The practical applications emerging from these data are also invaluable. While the bird and plant survey data, by design of my investigation, was a means to the end goal of accounting for the role of species abundance in determining their ecological role within mutualistic networks, it also represents an important body of information. Few surveys of the expansive agricultural territories of the Dominican Republic have been conducted, and this information could be used to update knowledge of threatened and potentially threatened populations. Several threatened species such as the Hispaniolan parrot, Hispaniolan parakeet, scaly-naped pigeon, and Hispaniolan crossbill have featured in our survey data, which has revealed seasonal patterns of site use from which migratory patterns can be inferred to help manage these species in the future. With respect to plant species, we now have extensive data on numerous rare plants that, according to professionals at the National Botanical Garden in Santo Domingo, were not previously documented in this region.

2. *Training Career Biologists & Ecologists*

During this past year, my project has supported one technician from the Dominican Republic and three volunteers representing three other countries (i.e. USA, Mexico, and Colombia). These opportunities have provided important life, cultural, and career experiences to these individuals, some of who may not have otherwise had access to an opportunity such as this. For my core project members, my project has served as a platform for hands-on skills and immersion in field-intensive research activities. We have also had particularly good results working with university students. Most academic coursework at these universities and technical schools – even those that are nominally integrated with biological and ecological majors and coursework – is primarily focused on either agriculture, agronomy, or forestry. Many students who are interested in wildlife and biodiversity simply have no opportunity to pursue these interests. We led an introductory workshop for ISA University in methods for bird biodiversity surveys. In the time since, I have helped the department of Ecology and Environmental Management at this university develop a curriculum for an ornithology course. By continuing to extend these opportunities to students, I believe it will be an important step toward changing the academic focus of curricula to emphasise these important elements of environmental studies and management. Furthermore, this educational focus will help promote progressive agendas in the institutions where these future leaders may go on to work.

3. *A Road Map for Ecological Restoration*

I believe that my investigations over the course of these past few years and the alliances that I have developed with other institutions is an important first step toward modernising habitat restoration practices on the island. The need for increasing tree cover in degraded lands is well recognised by working groups and leaders focused on sustainable development and natural resources management in the Dominican Republic. Many institutions tout the number of trees planted or surface area reforested as a measure of how successfully they are combatting the issues of loss of habitat and ecosystem services that accompany both historic and current deforestation activities. Yet, nearly all these projects use either tree species valued for their timber or those that have established seed trade and storage practices such that many of these trees are non-native or ecologically inappropriate for planting in particular areas. Not only have my studies demonstrated the natural regeneration processes in abandoned pasturelands, but our plant-frugivore network studies have uncovered plant species that are important resources for birds, which are the dominant vertebrates in the forest ecosystems of Hispaniola and realize important ecological functions as seed dispersers and insectivores. My future outreach involvements in the Dominican Republic will continue to emphasize a biodiversity-centric approach to forest restoration.

At this juncture, our original RSG study has provided us with a compelling demonstration of the potential natural role that birds play in facilitating recovery in abandoned pasture areas. Similar to other regions of Latin America, grazing pastures represent one of the largest forms of human-modified land cover in the Dominican Republic. Not only does this end point of deforestation reduce plant populations but also the native animals which rely on the structural habitat and the intrinsic value of particular species as food resources for native animals. There have been mixed results from the literature concerning the effects of artificial perches on regeneration of woody plants in degraded lands. While our current interpretation is made with caution due to the potential long-term importance of restoring the seed bank with plant species that can have extended dormancy before germination, our results overall suggest that perches and subsequent seed arrival alone does not lead to meaningful regeneration. Rather, suppression of grasses through shading and the accumulation of leaf litter – as exemplified by RSG I study plots beneath mango trees – seems to be critical for kick-starting the succession process, beyond which point avian seed dispersal become less inhibited. Emphasising both remnant and planted trees with these characteristics is, therefore, essential for successful management of these projects.

We have already begun to take the first steps toward enacting our recommendations. Recently, I was connected by a colleague to the executive director of the Dominican Environmental Consortium, who is helping to organise forest restoration projects in the community San Jose de Las Matas. I hope to advise these projects using the results from my studies. During the past 6 months, my project personnel and I have started a native species propagation project. We have successfully germinated and begun rearing seedlings from over 20 species of native trees and shrubs for use in restoration projects. Specifically, these will be planted in the restoration plots where we have been working for the past two years as well as new projects that will be initiated by Rancho Baiguate and Plan Yaque in the months to come. I have also taken the advice from some colleagues who are currently working on restoration projects in

Costa Rica to consider the use of live cuttings as a means of growing trees to larger size more quickly than small seedlings. We have already utilised *Gliricidia sepium* as fence posts; however, these are non-native and do not provide food resources to birds. I have begun to investigate in the literature as well as through a series of small tests in the nursery space to test fruit-producing species as candidate for this method of propagation.

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

The primary focus during this past year of the project has been the data collection from plant/bird surveys and foraging observations and secondarily on the management and monitoring of the experimental restoration plots. Therefore, community involvement has not been a central part of the project. However, there are several advancements that we have made in this area. Likely one of our greatest outreach achievements in this past year for the community of Jarabacoa has been the Christmas Bird Count. We were able to involve a handful of local nature enthusiasts, previous field assistants, and students from the Environmental Ministry School. The campus of this school, along with several other sites, has now been established as a census site for future years and presents a promising opportunity to continue to foster interest in birds and wildlife.

5. Are there any plans to continue this work?

At this time, the bulk of the field data collection for my thesis research is complete. However, I am currently coordinating with my local partners to ensure that the forest restoration projects will endure with proper supervision and the continued possibility for further data collection. The artificial perch study, in particular, presents a need for follow-up studies. Neither the perches installed in 2017 nor 2018 have yet showed significant seedling regeneration in their understory. We have reached the tentative conclusion that seeds of most species cannot survive and grow in the pasture conditions. Our experimental manipulations to remove grass and sod from beneath perches in 2017 was perhaps ineffectual, and these treatments were later revised in 2018. Thus, further monitoring beyond 1-2 years will further reveal whether or not these treatments will have had an effect.

Specifically related to seed dispersal ecology, there are no definitive plans to continue these investigations. However, several potential avenues have been identified to explore new research questions. For example, I hope one day to carry out similar investigations in the mountain forests at higher elevation. Many of the same bird species that we have studied for also inhabit these ecosystems despite these having remarkably different plant communities. Such studies might give important insight into the broad ecological niches of birds on islands like Hispaniola and their evolutionary history, which can help their conservation in the long-term.

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

Some of the results from this past year's work and prior research has already been presented through several scientific talks in past months, including most recently at

the 4th international meeting of the Caribaea Initiative in Santo Domingo. My research will be presented at two conferences this summer, the Ecological Society of America and BirdsCaribbean, as well as next year at the 7th international Frugivores and Seed Dispersal Symposium in India. Locally, in the Dominican Republic, I have offered to the department of Ecology and Environmental Management at ISA University and my local partner Plan Yaque to give lectures on the full synthesis of my research. This body of work supported by the Rufford Foundation will further be composed as a series of scientific journal publications, including three chapters of my doctoral dissertation – primarily focusing on plant-frugivore networks – and a several others covering forest restoration themes.

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

I originally anticipated that the RSG Booster Grant would be used to support my work from April 2018 to February 2019. Given that I was not granted the funds until June 2018, the work schedule was protracted. All expenditures credited to the grant were therefore during a 12-month period from June 2018 and May 2019.

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
Service Charges (printing, package shipping, etc.)	30	168	+138	Most of this difference was due to shipping costs on laboratory supplies (e.g. microfuge tubes & tube racks). While I did use a different grant to purchase these materials (see below), I used RSG funds to send them to the field site in the mail.
Mobile Phone Credit	100	54	-46	
Motorbike Maintenance (oil changes, part replacements, etc.)	160	502	+342	Several repairs to the motorbike were needed during the year that went beyond routine maintenance. Two of the bigger repairs included changing the shock absorption system and the wiring system for headlights and brake lights.
Diameter tape	30		-30	
Garmin GPS unit	180		-180	
Field Work Supplies (i.e. notebooks, pens,	80	106	+26	

biodegradable flagging tape, nails, screws, etc.)				
Laboratory Reagents (DNA buffer, silica extraction materials, primers, PCR/Sequencing)	750		-750	These materials were paid for using a different grant: the Paul W. Kirk Jr Wetland Research Award from Old Dominion University.
Seed Trap Equipment (PVC, screen, etc.	1,300	243	-1,057	These costs were reduced substantially by recycling materials used from previous years as well as a reduction of total seed traps deployed that was determined after the original budget was drafted.
Fence Labour	250	231	-17	
Bus/Taxi Fares	200	93	-107	I originally expected to make more trips to Santo Domingo to bring samples for identification at the national botanical garden. However, email correspondence and sharing photographs with these experts remotely reduced the number of trips that were needed.
Technician Wages	3,600	4,212	+612	The difference in this item was due to extending the contract of the technician to include the month of May 2019.
Food Supplies	350	554	+204	
Housing	1,200	1,300	+100	
Fuel (Motorbike)	180	294	+114	
Fuel (Rental Car)	195	325	+130	
Rental Vehicle	965	1,306	+341	
Tourist Visa & Surcharge Fee	50	65	+15	
Airfare	380	547	+167	
Total	**10,000**	**10,000**		

Note: exchange rates of $49.34 (DOP) = $1.00 (USD) and $1.3105 (USD) = £1.00 (GBP) were used for these calculations. The former was the average exchange rate over the course of the grant period, while the latter was calculated based on the conversion of British currency to US dollars when it was deposited in my bank account in June 2018.

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

In my judgment, the work that my project has completed in the past 3 years is an important step toward changing attitudes concerning research and conservation in the Dominican Republic. There is already a great deal of interest in reforestation in the

country. The challenge now will be to transition from a focus on simply planting trees toward more legitimate ecological restoration. This requires a greater recognition of native biodiversity of flora and fauna and its importance in the integrity and functioning of ecosystems. My study of plant-frugivore mutualisms is just one example of many potential aspects of forest ecosystems on which data and scientific study could be of great benefit to this more comprehensive understanding. I believe it is important for Dominican to become leaders in these types of studies. Unfortunately, very few institutions in the country take on such projects. Part of this is likely a lack of funding or knowledge of how to acquire funding, but another important limitation is the general lack of interest or awareness of these potential areas where scientific progress would be of great value. For this reason, investing in education at all levels is critical. From my own experience, I believe that focusing on improving the curricula and programmes of Dominican universities, where many environmental leaders receive their training, would be an effective means of bringing about needed reforms. Of course, many other basic environmental issues (i.e. pollution, plastic waste, irresponsible/illegal natural resource use) are in great need of being addressed. Given a notoriously poor enforcement of government-mandated environmental policies and law, a focus on social progress and grassroots education programmes are essential to mitigating these problems.

Now that the field work from my graduate research has officially concluded, my focus for at least the next year will be finishing my lab work, publishing the results of my studies, and finishing my degree. Alongside this objective, I fully intend to continue to work in the Dominican Republic that builds upon this project. My ambition in this regard is to use the non-profit organisation Verde Soy as a vehicle for long-term research and conservation work in the region. This organisation is still in the making, and we have drafted a mission statement and multiple proposals to begin projects. This organisation would focus on the following initiatives: land stewardship, habitat restoration, long-term research using bird observatory model, enriching Dominican higher education, and sustainable tourism and public outreach. Much of this work is already in progress in an unofficial sense, and we hope to find funding to start building this organisation as well as a fully developed plan for the long-term financial sustainability of this organization in the future.

In the short-term, this organisation would have four central initiatives: (1) developing a sustainable tourism to generate revenue, (2) designation and management of private protected areas, (3) ecological restoration of the aforementioned protected areas, and (4) developing a bird observatory. To develop tourism services to generate revenue, we would focus on training local bird guides and organising and promoting local tours to sites in the Cordillera Central and eventually island wide. We are also exploring the possibility of taking our modest native tree propagation project and expanding this to create a full-scale native tree nursery, which could function to supply government and NGO local partners for tree-planting projects of their own through sales or other external fundraising. We have already engaged local landowners and secured tentative agreements for small portions of their lands to be donated our organization for research, ecological restoration, and stewardship. As previously indicated, one of the primary objectives of our research would be to establish a bird observatory operating at multiple sites in the Cordillera Central. This bird observatory would focus on capture/mark techniques. As this organisation gains

traction, we would expand the observatory to include international collaboration through the Motus network to create a series of strategically placed receiver towers to log the signals of radio transmitter tags worn by migratory birds passing through the Dominican Republic. Such an observatory would be the first of its kind on the island and one of very few in the Caribbean region.

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

Yes. I used the Rufford logo at the end of all my research presentations.

11. Any other comments?

I and those who have represented my project would like to express our gratitude to The Rufford Foundation to make this work possible. Even though other funders have also supported my research, the two small grants and the booster grant have provided the core funding that was necessary to achieve continuity and to both set and achieve more ambitious objectives. While my research may be concluding, our work here has revealed numerous avenues for future work in research, conservation, and public education in the Dominican Republic. As such, I believe this support from these awards will have immeasurable value for years to come in laying this foundation.