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	Adedoja Opeyemi Adebayo
Project title	Insect-flower interaction networks vary among endemic pollinator taxa over an elevation gradient
RSG reference	20642-1
Reporting period	03/07/2017 - 19/11/2018
Amount of grant	£5000
Your email address	adedojaopeyemiadebayo@gmail.com
Date of this report	19/11/2018

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
To examine the influence of micro-climatic variables on insect-flower interaction networks				Temperature was the main factor driving the activities of flower-visiting insects and their composition across the elevation gradient. Temperature was highest at the base elevation and this decreased towards the peak elevation. We found high visitation frequency at the base and middle elevation and this declined towards the peak elevation. Overall, bees and beetles were mostly influenced by air temperature, however, there was no significant influence of air temperature on the activities and distribution of wasps and flies across the elevation gradient
To examine the differences in species abundance, richness, diversity and composition across elevation gradient.				The middle elevation, which is also an ecotone, had the highest abundance of flower-visiting insects and flowering plants and this was significantly different from the low abundance and species richness recorded at the peak elevation. Also, there was a significant difference in species composition of flower visiting insects most especially among species recorded at the middle zone and at the peak zone. Bees contributed mostly to the differences in species recorded at these two elevation followed by beetles and wasps, however, the composition of flies was relatively similar across elevations. Here we stressed out the importance of habitat connectedness in aiding species distribution and diversity across elevation gradient. Habitat isolation hindered species distribution across elevation gradient as seen from the low diversity recorded at the peak elevation in our study

To understand the response of network properties to changes across elevation gradient				Network generality, Network Shannon diversity and linkage density were significantly difference across elevation gradient with the highest records at the middle elevation (ecotone) and lowest at peak elevation. Networks at the middle elevation were relatively stable in response to environmental stress with more flowering plant species available in interactions for flower visiting insects. However, our study showed low interacting partners at the peak elevation with a weak network which could break down with further loss of species in mutualism at this elevation. Furthermore, we stress out the importance of habitat connectedness in aiding insect-flower interaction networks. Also, the climatic condition at the peak elevation is relatively unstable and this may yield temporal loss in species restricted to this zone
To examine how flower-visiting insects track the composition of flowering plants across the elevation gradient				Here we assessed whether the composition of flower-visiting insects tracks the already established differences in flowering plant distribution across the elevation gradient. Indeed, flower-visiting insect composition differences responds to changes in flowering plants species composition across the elevation differences. This is important for sensitive species at the peak elevation. Loss of the plant species in this region may have a cascading effect on the flower-visiting insects that depend on them for flora requirements. Overall, this may also yield a breakdown in interaction network at this zone.
To understand how species phenology changes among taxonomic groups				Here, we collected data from August to November 2017 and August to November 2018. So far, bees peaked in abundance earlier than other taxonomic group. Also, while peak in abundance of bees tracks flowering plant at the base zone, there was a mismatch at the middle zone where bees peaked earlier than flowering

				plants. We are conducting further analysis to understand the significance of the spatio-temporal pattern observed here over the sampling period

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

There was a drought in 2017 which affected flowering plant species, especially at the peak elevation on our study site. However, we were able to secure three study sites at the peak elevation and five study sites at other elevations. We also had other unplanned circumstance like vehicle breakdowns and weather factors.

We did not include accommodation and feeding during the period of the study in our initial budget plan. We finally had prioritise our needs to for the project and utilised the grant for the most important items needed for the project.

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

1. Elevation indeed shape phenology of flower-visiting insects and flowering plants. Bees peaked in abundance earlier than other taxonomic group and we also observed a mismatch among peak period of bees and flowering plants at the middle elevation zone. This mean, while plants are at the peak of flowering, the bees are declining in abundance. This is a major threat to species productivity at this zone and may have a negative implication for species diversity at this zone in the future.

2. Elevation also structures species composition. Flower visiting insect species composition segregated significantly across elevation zones. The major differences we observed were between insect species at the middle zone and peak zone. This showed some level of isolation in species distribution across our mountain. The segregation among insects also tracks flowering plant composition. This shows the strength of mutualism among the insect and plant on this mountain. This may be crucial for important specialist species on our mountain where a loss in flowering plant will result in loss of flower-visiting insect taxa that depend on the plant in interaction.

3. Elevation also influence insect-flower interaction networks as we observed a decline in visitation rate at higher elevation. Interaction frequency was highest at the middle zone which is also an ecotone. This was primarily driven by flowering plant abundance and area of display. However, we observed different factors influencing the activities of different insect taxa in interaction across elevation zones. While temperature was the only factor influencing the activities of bees, beetles on the other hand was primarily influenced by temperature in association with flower abundance and area of display. Wasps and flies showed no significant response pattern across elevation. Here we showed bees and beetles as the most important taxa that can be used as

suitable indicator of changes in environmental conditions across elevation gradient.

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

Four members of the community assisted me in the course of the study. I had one university student that was stable during the first sampling season. Two other students worked with me on per diems in the field at the second sampling year. Another university student helped with insect sorting and identification in the laboratory.

5. Are there any plans to continue this work?

I plan to continue this work by assessing how the flowering plant productivity is influenced by temporal mismatch pattern observed in our current study between bees and flowering plants

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

One of the manuscript on this research has been accepted in PloS one journal and currently in press. I am working on another manuscript which will also be submitted to another journal. During the course of this research, I made a presentation of the study at a conference here in the university where I shared my work with colleagues and leading researchers. I also had the opportunity to attend the Student Conference on Conservation Science, New York where I also presented the research to the general audience and leading researchers.

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 over the period of 17 months. I had to request for an extension as I sampled in two seasons of 2 different years.

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
Camera and Lens	240	380	-140	I bought the camera for 330 and I was also loaned a lens for 150 during the period of field work, I only used 50 from this grant and utilised other grants for the balance

Pan traps	265	200	+65	I used some of the traps used by a former PhD student in the department, however, some of these pan traps were damaged and I had to arrange for replacements.
Sweep net	120	0	+120	A researcher loaned me some sweep nets in the department for the period of the study
Ethanol	60	100	-40	
Books and Field guild	250	200	+50	
Laboratory and museum identification fee	300	0	+300	We used funding from other source to cover this expense
Standard insect box	240	150	+90	
Folding insect box	295	0	+295	We could not purchase this as there were more pressing need for the study
Field assistant	1000	1000	0	My budget for field assistance was for 1 person. I contracted four people over the sampling period. I utilised funding from other grants to fill the gaps
Entomological pins	50	50	0	
Feeding	0	800	-800	This was not included in the initial budget
Accommodation	0	865	-865	This also was not included in the initial budget
Transportation	1000	810	+160	
Binoculars	175	175	0	
GPS Battery, liquid detergents, battery for handheld thermometer, battery for weather station and stationary materials	0	270	-250	We used some of the money from the grants to cover some of daily needs as listed
TOTAL	5000	5000		Exchange rate: 1£ =17.4 Rands at the time of grant utilisation

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

The project raised more research questions which are important for species conservation on this mountain. We saw evidences of mismatch in abundance peaks of bees and flowering plants here, also how compositional differences shape this pattern. I will be looking more closely in another study at species level into pollination success and flowering plant productivity in the phase of mismatches between pollinator and plant. This will quantify how much is lost to different appearance time observed between the two trophic levels. I will be applying for another research

grant to conduct this study after the successful completion of my second manuscript.

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?

The Rufford Foundation logo was placed on my presentation at the research day in my university and also at the Student Conference on Conservation Science (SCCS), New York. The Rufford foundation was also acknowledged in the accepted manuscript in PloS one Journal. The foundation will also be acknowledged in my future publications on this study.

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

Ms Richelle Brink – Field assistant

Ms Loriane Yanclo – Field assistant

Mr Ajila Gbenga – Field assistant

Mr Muhammed Gardee – Insect sorting in the laboratory

Prof Michael Samways – Supervision

Dr Tope Kehinde – Supervision

12. Any other comments?

This project produced answers to important ecological questions which have not received attention in this biodiversity hotspot until now. With my output here, I believe more research will be conducted on understanding the long-term impact of my finding in this ecosystem. I will like to thank the Rufford Foundation for the opportunity to conduct this research.

Collection of insects caught in our pan traps over the sampling period

Sorting of insects in different taxa