

Final Evaluation Report

Your Details	
Full Name	Leo Malingati Khasoha
Project Title	Correlating diet breadth and survival to explain abundance-occupancy relationships in small mammals: Species extinctions and Conservation insights
Application ID	29561-1
Grant Amount	£5997
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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
Quantifying the dietary components of the small mammals of Mpala Conservancy through DNA metabarcoding				Out of a community of approximately 10 species, the diet of three most abundant species was fully quantified, two rare and restricted species partially quantified, and the remaining five species were not quantified. Few to no samples were generally collected from the rare, restricted species. More effort was put into collecting samples from the rare species after the faecal samples DNA analysis, but unfortunately the samples were not analysed due to financial constraints and the expensive nature of conducting DNA analyses.
Correlating the degree of dietary generalism/specialisation to the fitness of species via abundance and occupancy as proxies of fitness				A correlation of degree of dietary specialisation between different species was fully done for five species. Small mammal abundance was monitored every other month with faecal sample collection across seasons. The mammals were ear tagged for monitoring abundance, faecal samples were analysed for degree of diet specialisation, and correlations drawn from the measures. The abundant, widespread species were generalists at the population level whereas rare, restricted species were specialists.
Building the capacity of budding small mammal biologists through hands on field work				Through a cordial partnership between Mpala Conservancy and National Museums of Kenya, I fully trained two interns from National Museums of Kenya (George Legrange, BSc Natural Resource and Cate Lonyagaita, Diploma Wildlife Management). The two

			<p>have been absorbed by Mpala Conservancy as small mammal research assistants. I also trained two visiting students on small mammal handling (Sarah Weiner, currently a research intern with Save the Elephants in Tsavo and Courtney Reeds, PhD student at Brown University with her dissertation in small mammals of Mpala Conservancy).</p> <p>More small mammal biologists need training and exposure.</p>
Sensitizing the public on small mammals of Laikipia Kenya			<p>I have successfully given talks and presentations to both the scientific and non-scientific groups through Zoom lectures to students (i.e., Princeton University undergraduate students through Mpala Conservancy), in person workshops (i.e., I gave a talk on ecology of Laikipia small mammals to a Teachers Wildlife Workshop organised by Wildlife Direct Kenya), and random talks to the community around Mpala. I was able to partner with Wildlife Direct to film the small mammal work and soon the film will be out for public on YouTube and local TV channels airing.</p>

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

The ongoing Covid 19 pandemic greatly affected my project work forcing me to postpone field work at times because of inter-country lockdowns and unexpectedly high travel costs for field work in keeping with guidelines of the pandemic.

Moreover, there were extremely few representatives from the rare, restricted subset of small mammals to allow for comparisons with the abundant, widespread subset.

This challenge necessitated more sampling effort with increased effort to collect samples from the rare, restricted species. The efforts yielded but unfortunately, I was not able to analyse the extra samples due to financial constraints and difficulties in sample exportation as a result of movement cessations and diverted attentions to the pandemic. However, given more funds the samples can be analysed for confident comparisons and conclusions for what drives abundance and occupancy in the Mpala Conservancy small mammal community.

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

1. Capacity building and public sensitisation: I successfully trained three budding small mammal biologists, two of whom have been employed at Mpala Research Centre as small mammal technicians. I also sensitised 15 primary and secondary school teachers drawn from different parts of Kenya on the ecology of small mammals of Laikipia in a workshop organized by wildlife direct. Additionally, the small mammal work was filmed by Wildlife Warriors, and it will soon be aired on Kenyan local TV channels after the editing is done.



Figure 1: The Wildlife Warriors/ Wildlife Direct filming crew filming the small mammal work on an early morning of checking traps and sampling for faecal. Small mammal traps are checked early in the morning before the intense sun of the savanna to prevent animal trap death from heat.



Figure 2: Photos from the public sensitization session of Wildlife Warriors Teachers Conference held at Mpala Research Center organized by Wildlife Direct. Photo A: Leo M. Khasoha takes the teachers through the sample's preparation procedure in the lab before DNA analysis to identify the different plants species consumed by the small mammals. Photo B: Leo M. Khasoha takes the teachers through a demonstration of setting small mammal traps and handling and sampling the animals for faecal samples. Photo C: Leo M. Khasoha takes the teachers through a presentation on ecology of the small mammals of Laikipia. Photo credit @WildlifeDirect

2. Small mammal identification key and diet profile for Mpala: We successfully developed a small mammal identification key for the UHURU experimental plots with a brief description of the animals and their photographs. The key will be helpful to other scientists wishing to study small mammals in Laikipia. Additionally, we currently have a diet profile of the diet of small mammals in the wild and their relative use of different species of plants across seasons.

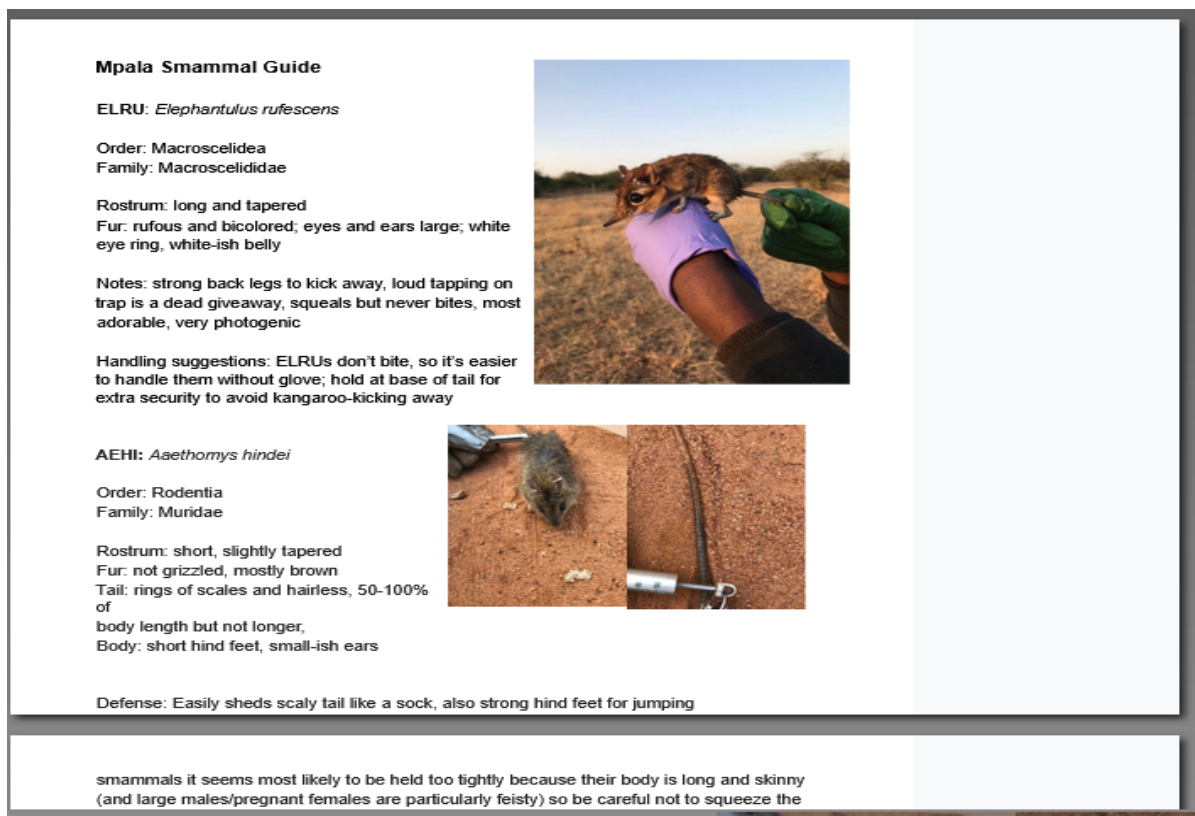


Figure 3: The small mammal guide for the small mammals of Mpala prepared by Sarah Weiner and Leo M. Khasoha

3. PhD dissertation and master's degree thesis: I have successfully done a thesis for my MSc in Biology of Conservation with the University of Nairobi (Kenya) supervised by Dr. Evans M. Mwangi a lecturer with the School of Biological Sciences, University of Nairobi. Moreover, through this work I was awarded a PhD scholarship with the University of Wyoming, USA and this work is forming my first chapter.

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

I trained one Wildlife Management diploma local graduate and one intern from mammalogy section of National Museums of Kenya on small mammal field techniques. Fortunately, they were both absorbed with Mpala Research Centre as small mammal technicians. Moreover, I hired and involved two locals as research assistants from field data collection to lab processing of faecal samples.



Figure 4: The project field crew after a morning of sampling. From the left George Legrange (BSc. Wildlife Management, Intern at Mammalogy Section of National Museums of Kenya, and currently a small mammal technician at Mpala Research Centre), Cate Lonyagaita (Diploma Wildlife Management, and currently a small mammal technician at Mpala Research Centre), Gilbert Busienei and Peter Lokeny (field research assistants from the community), and Leo M. Khasoha (Principal Investigator of the project)

5. Are there any plans to continue this work?

Yes, this project has become the foundation of my PhD dissertation forming the first chapter of my dissertation. I intend to field test more explanations for abundance-occupancy relationships. Currently am in the process of developing a manuscript for Journal of Mammalogy and intend to test the role of dispersal in maintaining species in a positive abundance-occupancy relationships.

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

1. Sharing the small mammals guide with locals and other scientists studying or intending to study small mammals of Laikipia or Mpala.
2. A publication to the Journal of Mammalogy is in preparation for sharing results to the scientific community.
3. I intend to continue presenting my results to publics as I have done with the Teachers Conference, Princeton Students, and soon with Nature Kenya membership.

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

The grant was spent over a period of 15 months against the intended 12 months because of covid related lockdown challenges that curtailed travel for field work.

8. Budget: 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. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
1 pc of camera	348	348		
1 pc of laptop	353		-353	Idea Wild small grants for field equipment supported the project with a laptop but I had to buy an external drive to help safely store data. The laptop funds were used to cover the budget difference
1 pc external hard drive		25	+25	For safe storage of data, I bought an external drive.
1 research assistant stipend for 104 days	1917	1955	+38	Field days increased by 2
1 pc of battery charger	18	18		
Accommodation and food at Mpala Research Centre for 120 days	2647	2887	+240	I spent extra days for each sampling period to double check data and make sure all the samples are well labelled
Local travel for field work	421	421		
Trapping baits supplies (oats)	103	132	+29	
Printing, communication, and flagging tapes for marking sampling sites	190	211	21	
TOTAL	5997	5997	0	

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

Understanding what shapes abundance and occurrence in communities is extremely important for management of both rare species that might be endangered, and abundant species that might be invasive. The most important step

with this project is analysing more samples from the rare subsets for confident inferences on how dietary niche width shapes abundance and occupancy relationships. The next important step will be testing the role of dispersal in maintaining communities that differ in abundance and occurrence, and if and whether abundant, widespread species suppress positive growth of the rare, restricted species. Lastly, it will be important to experiment how resource removal affects species community composed of abundant, widespread and rare, restricted species. Increased anthropogenic activities and climate change are increasingly decreasing the resources available for species, and it is important to predict how different species will be affected based on their biology.

10. 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, I have fully acknowledged Rufford in all my presentations by using Rufford logo in the “thank you” section.

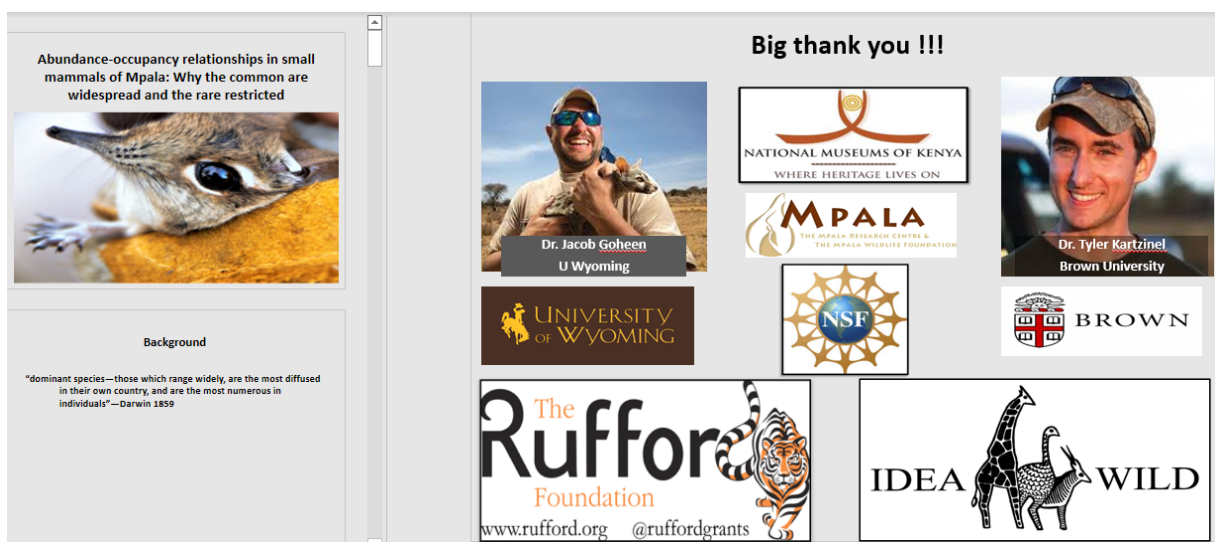


Figure 5: A screenshot of a presentation to Princeton University undergraduate students on what explains commonness, rarity, and distribution of small mammals on Mpala Conservancy. I acknowledged all the funders, and people and institutions that were impactful throughout the project implementation and data analysis.

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

Leo M. Khasoha: Principal Investigator; conceived the idea and experimental design, collected data, analysed the data, and supervised the field crew

Gilbert Busienei: Community field assistant; collected data and drove the crew to the field

George Legrange: National Museums of Kenya Intern; collected data, processed samples in the lab, and entered data

Cate Lonyagaita: National Museums of Kenya Intern; collected data, processed samples in the lab, and entered data

Sarah Weiner: Field Assistant; collected data, and handled field logistics

Courtney Reeds: Field Assistant and DNA metabarcoding expert; analysed faecal samples for DNA at Kartnizel Lab (Brown University, USA)

Dr. Jacob R. Goheen: Graduate Adviser and PI of UHURU experimental plots in which we conducted the study; offered advice throughout the project implementation and data analyses

Dr. Tyler Kartnizel: Collaborator; funded the faecal samples analyses and offered the faecal samples collection, processing, and analyses protocol

12. Any other comments?

We are greatly indebted to The Rufford Foundation for the generous support that made this work a success, for entrusting me (Leo) with this grant to make a substantive impact to science by both training budding ecologists and attempting to disentangle the complexities surrounding abundance-occupancy relationships.

We also thank Mammalogy Section of National Museums of Kenya for the mutual collaboration with offering interns who helped in data collection; Mpala Research Centre for facilitating our field and lab works; UHURU experiment PIs for allowing us to conduct research in their experimental plots; and Wildlife Direct for agreeing to film our work and involving us in their citizen science initiatives.