Final Evaluation Report

Your Details	
Full Name	Douglas Kamaru Njeri
Project Title	Linkages Between Mutualism Breakdown, Landscape Change, and Predator-Prey Dynamics in a Human-Occupied Savanna
Application ID	29681-1
Grant Amount	£6000
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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
Mapping areas of high whistling-thorn tree (acacia drepanolobium) damage by the elephants due to big-headed ants' invasion in Ol Pejeta conservancy.			☑	*Acacia drepanolobium* bushland makes up ~60% of the habitat in Ol Pejeta Conservancy and constitutes ~75% food for the critically endangered black rhinos in the conservancy and facilitate cover for prey ambush by lions. However, over a period of 20 years, there has been an increase in tree damage by elephants due to invasion by the big-headed ants. Big-headed ants kill and displace the native ants which defend this tree from heavy herbivory, thereby rendering the trees defenceless against elephant damage, decreasing food availability for the black rhinos and impacts on hunting success of the lion due to decreased cover for concealment.
Quantify how ant invasion triggers shifts in habitat selection by zebras (key lion prey) at Ol Pejeta conservancy.			☑	Plains zebras comprise the bulk (>50%) of lion kills at Ol Pejeta Conservancy, and >90% of predation events on zebra are attributable to lions. I quantified spatial and temporal variation in zebra density through drive transects and camera trapping.
Identifying the effects of big-headed ant invasion on lion-prey interactions and hunting success.		☑		Between June 2019 and September 2020, I identified 65 zebra kill sites. There's needed to increase sample size to ~150 kill sites.

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

Cancellation and rescheduling of fieldworks due to Covid-19, to ensure that all the participants were safe. I also had to reduce the number of placement students to

conform with the conservancy's Covid-19 protocol, and worked with a small and manageable team, consequently delaying the completion of the project.

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

Outcome 1: Produced a map of big-headed ant invasion areas within the conservancy. The big-headed ants facilitate increase damage of acacia trees by elephants. This map will help the management, to select exclusion zones in areas that are highly damaged to allow tree regeneration within the conservancy. My results demonstrated that exclusion of the mega herbivores even when the areas is invaded by the big-headed ants would significantly reduce damage and encourage tree regeneration.


Left: Uninvaded site. Right: Invaded site.

Outcome 2: Produced a spatial distribution map of density surfaces for zebra within the entire Ol Pejeta Conservancy and determined the effects of big-headed ant in influencing spatial distribution of zebras in the conservancy. My work demonstrated that big-headed ants have an indirect effect on zebra distribution within the conservancy via increased visibility as a result decreased tree cover from elephant damages. Zebras selected areas invaded by the big-headed ants.

Left: Camera trapping. Right: Zebra density estimate map.
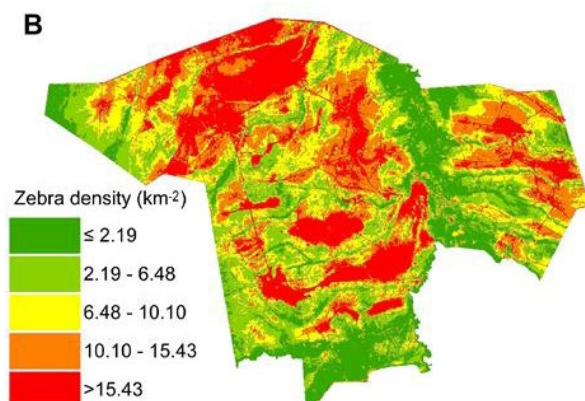
Outcome 3: My work demonstrates that the disruption of an ant-plant mutualism reorganised predator-prey dynamics involving lions and their primary prey, plains zebra. Invasion by the big-headed ant made a foundation species, the whistling

thorn tree, more palatable to elephants, reducing tree biomass by >40% in invaded areas relative to uninvaded areas. The reduction of tree biomass increased visibility, which was correlated with selection by (and thus densities of) zebra. Predation risk by lions (as assayed by the occurrence of kill sites) decreased in invaded areas, even though zebra densities were higher in invaded areas.

4. What do you consider to be the most significant achievement of this work?

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

I engaged students from community schools adjacent to Ol Pejeta Conservancy and from local universities. I involved student from local colleges and universities, on a conservation mentorship programme and offered placements to students from the Wildlife Research and Training Institute (WRTI), Karatina University and the University of Nairobi, to give them a rare chance to experience conservation and science, hence giving them hands-on skills at young age. Students were engaged in deployment and servicing of the camera traps, image classification for analysis, animal counts on transects and lion tracking.

Left: Mike (my colleague) demonstrating kill site assessment to the internship students from WRTI and the University of Nairobi. Right: Brenda a student from WRTI collecting lion scat, for scat and genetic analysis.

6. Are there any plans to continue this work?

There are plans to continue with this work, as well as replicate the same project in other areas that are invaded by the big-headed ants in Kenya.

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

I have been sharing quarterly reports from this project with Ol Pejeta Conservancy management who are keenly interested in research and conservation outcomes

stemming from my thesis. Additionally, once completed, I will facilitate a workshop among ranch managers and conservationists in Laikipia to share and discuss results.

To communicate my work to a wide international audience, my results and raw data will be made publicly available through peer open access publications and freely available online data repositories (such as Dryad); my advisor and his previous students from Kenya have been successful in publishing and disseminating work to the wider public. Finally, there is strong potential to develop a documentary showcasing my work through Wildlife Warriors, a Kenyan television programme with an international audience through YouTube. I also gave talks to visiting international students from the University of Wyoming.

Douglas Kamaru giving a talk to University of Wyoming students about lion tracking.

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

Although the Rufford funds were delayed due to Covid-19, I had anticipated to use the Rufford grant June 2020 to May 2021 but used it November 2020 to August 2021. This due to delayed disbursement of the fund and rescheduling of fieldwork activities due to Covid-19.

9. 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
12 Months of fuel for fieldwork to facilitate drive transects.	1992	2100	+108	Difference is due to fluctuating fuel prices
2 sets of binoculars (Model; Bushnell preferably).	310	310		
GPS Garmin 64s	249	265	+16	
AA Batteries for 7 camera traps (12 batteries per each camera).	160	190	+30	
SD Cards for 7 camera traps (SanDisk 8GB class4 SD flash memory card).50	50	95	+45	
Camera (Model; Canon EOS Rebel T6 Digital SLR camera preferably).	400	390	-10	
Stationary	39		-39	
Additional cameras traps for deployment in the field; I have less 7 cameras to complete a grid of 3x3 with 9 cameras in each site (6 sites) (model: Reconyx Hyperfire 2 HF2X covert IR preferably)	2800	2394	-406	
Sub-total	**6000**	**5744**	**-256**	
10% administrative fee		600	+600	A 10% administrative fee charged in respect of holding funds.
TOTAL	**6000**	**6344**	**+344**	

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

The next step is the implementation of my recommendation by the management of the Ol Pejeta Conservancy. One of the recommendations is to find a way to curb further spread of the big-headed ants within the conservancy, and second recommendation is the need to prioritise the exclusion experiment that will exclude all herbivores to confer recovery of damaged mature trees while providing seedling recruitment of the whistling-thorn tree in areas where over 60% trees have been damaged.

11. 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?

I used the Rufford Foundation logo in all my presentations. I will be attending and make a presentation about my project in the 2022 American Society of Mammologist in Arizona, USA.

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

I work closely with my supervisors **Dr. Jacob Goheen**, an ecologist and lecturer in the Department of Zoology & Physiology at the University of Wyoming in the USA (http://www.jakegoheen.com/index.php/research-group.html). Dr. Goheen is an expert ecologist with wealth of experiences on predator-prey dynamics and invasion ecology and has published extensively in various peer reviewed journals and book chapters. **Dr. Robert Chira** is my local advisor through the College of Physical and Biological Sciences at the University of Nairobi (https://profiles.uonbi.ac.ke/content/dr-robert-mutugi-chira-profile); he is an expert ecologist with extensive experiences in data analysis and models. I am also working with **Mr. Michael O'gutu**, my field technician. Michael has extensive experiences in data collection in the field, camera trapping and image classification, his organization skills facilitated the smooth running of the project.

13. Any other comments?

I am thankful to Rufford Foundation for partnering with me on this project to understand the cascading effects of the big-headed ants on predator-prey dynamics involving lions and plain zebra.