Final Evaluation Report

Your Details	
Full Name	Grace Warner
Project Title	Microhabitat density and buffering capacity in an arid landscape - A valuable resource for a changing climate
Application ID	35202-1
Date of this Report	08 November 2022

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
Establish the distribution and density of 5 distinct microhabitat types of various size classes, within distinct habitats in the Kalahari.				This objective was achieved fully for all five microhabitat types (bird nests, tree hollows, rock crevices, burrows, and vegetation cover), across three distinct habitat types (plains, mountains, and dunes) within the study site.
Assess if there is an association between type of microhabitat and the soil type, slope, aspect, and habitat type in which it occurs				This objective was only partially achieved because we did not look at soil type. Assessing soil type was too time consuming for the given time period, and soil gradients changed too frequently and erratically within the study site for us to draw clear conclusions. All other parts of this objective were achieved in full.
Identify which animals use the available microhabitats, and assess if temporal, spatial or behavioural patterns exist for specific microhabitats				This objective was removed from the study after our preliminary surveys, as the scope of the project became too large for an MSc. We also needed a higher resolution of thermal data. Thus, to cover all size classes of microhabitats, we used the camera trap budget towards purchasing further thermal loggers for this, and to replace loggers lost to wildlife tampering (See point 3).
Evaluate the thermal buffering capacity of 5 distinct microhabitat types of various size classes across seasonal and habitat gradients				This objective was achieved fully for all five tested microhabitats (bird nests, tree hollows, rock crevices, burrows, and vegetation cover), across three distinct habitat types (plains, mountains, and dunes) within the study site. For each microhabitat type, three size categories were tested, excluding bird nests and tree hollows which had two categories each. Data for all four seasons were collected over a period of 10 months.
Assess if there is an association between				This objective was added after preliminary fieldwork and was

thermal buffering capacity and topographic features, microhabitat position, habitat type and season				achieved fully. The relationship between topographic aspects and thermal buffering were tested for in vegetation, burrows and rock crevices, in the dunes and mountain habitat. The plains habitat was not tested as it was topographically flat. The effects of microhabitat position (classified as below-, on-, or above-ground), seasonal effects, and habitat type on thermal buffering were tested across all microhabitats.

2. Describe the three most important outcomes of your project.

a) The data generated by our study has provided a baseline measure of the abundance of potential microhabitats, and their abiotic and biotic drivers, which shape arid ecosystems. Potential microrefugia for climate change are usually associated with topographic variation. However, our study, as one of the first to assess microhabitat distribution in Southern Africa, suggests that microhabitat abundance differs according to microhabitat type, and across both habitat and topographic gradients. Thus, these data have highlighted that microhabitat abundance within our African savanna areas may exist rather because of the relationships between biotic communities and abiotic forces such as lowland topography, soil characteristics and fire prevalence, rather than shaped by topography alone.

b) There is very limited microclimatic data from extreme environments worldwide and we have produced a fine resolution thermal dataset that can be used for further mechanistic modelling to assess habitat suitability and species vulnerability in arid Southern African areas. Furthermore, this microclimatic data has provided a reference of how much microclimatic shelter may be available to animals in similar arid areas across Africa.

c) Through our data, we have been able to highlight the importance of ecosystem engineering species that will provide invaluable thermal shelters, by reducing effective climate exposure, for multiple other animals under climate change. Lastly, by assessing different sizes and positions of microhabitats, we have identified that birds and large mammals, due to their restricted access to extremely well buffered microhabitats, and their reliance on vegetation-based shelters, may be more at risk under increasing aridification and further climatic changes.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

COVID-related stock issues caused some of the equipment orders to be delayed, which caused the start date of the thermal data collection to be delayed. However, this delay did not have a lasting impact, and the final amount of data was only decreased from 12 to 10 months, with all four seasons still represented. Data loss also occurred on a few occasions due to tampering or removal of thermal loggers by wildlife. Although it is a common problem to this field of study, it was still problematic to mitigate. To minimise data loss, we checked all loggers every 10 days to ensure that they were not disrupted, and all loggers were collected, downloaded, and redeployed on a bi-monthly schedule. Although we attempted numerous solutions to minimise wildlife disruption, from moving field sites to placing edible bitter solution on the loggers, a total of 37 data loggers were still lost. Nonetheless, although the loss of loggers was costly, given our downloading schedule, no significant amount of data was lost.

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

This project was part of the Kalahari Endangered Ecosystem Project (KEEP), and as such, is a collaboration between multiple South African universities. Thus, as a member of this collaboration, many researchers from other projects, as well as other South African conservation students (not associated with KEEP), assisted with and observed parts of this project fieldwork. Through this process, we highlighted the importance of thermal biology and microclimates, as many students could see hands-on what both the methods, and resultant data looked like. Furthermore, as students living on the Tswalu Kalahari Reserve, we often interacted with both reserve guests and staff, providing information sessions on the methods and impacts of our work.

5. Are there any plans to continue this work?

There are no plans to continue this work with me (Grace Warner) as the lead researcher. However, the work surrounding how animals utilise microhabitats and the physiological effects of this usage, will be continued by fellow researchers within the Kalahari Endangered Ecosystem Project.

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

Once the MSc thesis has been submitted (January 2023), we aim to produce and publish at least two academic articles in relevant academic journals. As of yet, the results and methods of this study have been shared via multiple public presentations as listed below:

- Project methods and preliminary findings were presented at the Wildlife Conservation Physiology in a Changing World workshop (February 2022).
- The findings of the thermal buffering chapter were presented as a poster, online, for the University of the Witwatersrand Postgraduate Symposium (July 2022).
- A summary of our findings was presented at the South African Wildlife Management Association conference (the presentation won the best MSc speed presentation award) (September 2022).
- The findings of the thermal buffering chapter were presented as a poster, in-person, at the Oppenheimer Research Conference (October 2022).

The data may still potentially be distributed to other databases, such as SoilTemp (a global database for microclimatic data -https://soiltemp.weebly.com/). This distribution is pending negotiations, but if approved, will allow for the data to be used freely for future mechanistic modelling projects worldwide.

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

Although our study aimed to provide broad-scale insight on the drivers of a variety of microhabitat abundance and buffering capacities, we found no clear-cut signals at this resolution. Thus, the next steps that should be taken with regards to microclimate studies in arid regions, should be to target microhabitats and habitat types on a more individual level. For example, more intensive sampling effort of vegetation around the bases of mountains could identify how the steepness of a mountain may be associated with vegetation-dependent microhabitat prevalence in valleys. Furthermore, although fire and herbivory are known to be important drivers of savanna ecosystem maintenance, they are rarely associated with microclimate formation. Thus, an assessment of the associations between biotic microhabitats and abiotic gradients, such as soil type and fire prevalence, in flat plains-type areas could contribute to gaining knowledge on the formation of microhabitats in absence of topographic heterogeneity. Lastly, we have identified that burrows, rock crevices and tree hollows are exceptional thermal shelters, yet our dataset only provides 1 year of data. To assess if a microhabitat will be suitable as a micro refuge, it needs to remain thermally stable over generational time scales. Thus, it would be beneficial to continue acquiring long-term thermal data for these microhabitats. This kind of long-term data would thus allow us to assess if, even under increasing climate change, these microhabitats remain a viable option for shelter.

8. 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?

The Rufford Foundation logo was used in the acknowledgements section of all presentations listed at point 6.

9. Provide a full list of all the members of your team and their role in the project.

Grace Warner: Project lead

Graham Alexander: Academic supervisor

Andrea Fuller: Academic supervisor

Wendy Panaino: K.E.E.P manager and field-work advisor

Thilo Beck: Field assistance

10. Any other comments?

Burrow. © T Beck.


Exposure risk. © G Warner.


Rock crevices. © T Beck.

Fieldwork. © T Beck.

Tree hollows. © G Warner.