Final Evaluation Report

Your Details	
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Project Title	Prioritizing Underground roosts for Bats of Kenya
Application ID	42704-1
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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
Assess anthropogenic activities within and around bat caves			Yes	This objective was successfully met through comprehensive field surveys, local community involvement, and direct observations. These findings provided essential context for understanding the pressures facing cave-roosting bats and informed the development of vulnerability metrics. A purposive sampling approach was employed to select 12 cave sites for this study. The selection was guided by three main criteria: accessibility, presence of bats, and variation in human disturbance levels. Caves across Kenya's three ecological regions — Coastal/Southeastern(8 caves), Rift Valley(3 caves), and Western(1 cave)—based on documented underground bat roosts from literature (Musila et al., 2019; Simons, 1979; Wilson et al., 2015) . These caves were chosen to represent a gradient of human disturbance levels and protection status . Protected caves included those located within national parks and conservancies, which provide varying degrees of human access control, while unprotected caves on community lands experience greater disturbance from agricultural practices, grazing, and local settlements. Coastal caves such as Mdenyenye and Kisimani occur in humid tropical climates and are subject to high anthropogenic pressures, including tourism and agriculture. In the Rift Valley, caves like Mt. Suswa caves (situated within a conservancy), Maumau cave

				(Kenya Forest Service-managed Forest), and Lionhill cave (located in Lake Nakuru National Park) lie in savannah and woodland landscapes with moderate disturbance from regulated activities such as hiking and controlled settlement expansion. The Western region is represented solely by Kapsetai cave, selected due to its montane climate and notably higher agricultural pressure resulting from subsistence farming driven by local climatic conditions. Only natural underground roosts were selected to ensure relevance to ecologically stable habitats; artificial roosts were excluded due to their less complex microhabitats and opportunistic bat use. Two automatic bat detectors (Song Meter SM4BAT, Wildlife Acoustics, USA) were used to record bat echolocation calls at each cave. While small caves were sampled for a single night, with detectors operating from dusk to dawn, large caves with multiple chambers were recorded over two nights in a row. The detectors were set up to begin recording 30 minutes before sunset and to stop 30 minutes after sunrise. They were positioned one meter above the ground. Every morning before 0800 hours, devices were retrieved to download and process data. This was to ensure that the nightly bat emergence and return times were fully covered. The goal of acoustic sampling was to identify bat species based on call structure and frequency. To analyse the spatial context of bat caves, geospatial analyses were conducted using ArcGIS and remote sensing data. Cave locations recorded via GPS were mapped onto a national basemap featuring topography, rivers, urban canters, and forest cover for contextual interpretation. Proximity analyses calculated Euclidean distances from each cave to the nearest urban area, road, and water body. Vegetation structure around caves was assessed

				through tree density estimates derived from classified Normalized Difference Vegetation Index (NDVI) values obtained from Sentinel-2 imagery. In addition to spatial analyses, on-site assessments of human activities were recorded at each cave to capture direct anthropogenic disturbances not evident in remote data. Observations focused on four key disturbance categories: cave use intensity (e.g., guano harvesting, tourism, religious use), habitat loss (e.g., deforestation near cave entrances), pollution (e.g., litter), and structural disturbance (e.g., vegetation clearance). These activities were recorded using a standardized observation checklist. Each activity was scored based on its observed intensity and frequency to enable comparison across sites. This dataset was then used alongside spatial disturbance gradients to examine their effects on bat community composition. **Local and Ranger Guide Support** During the fieldwork, we were supported by local full-time guides and rangers across the study regions as follows: **Southeastern/Coastal Region:** South Coast: One local guide North Coast: One local guide Chyulu Hills:Guano and Kisula caves One ranger guide from Chyulu Hills National Park. **Rift Valley Region:** Mt. Suswa: One local guide Maumau: One guide Lake Nakuru: A ranger from Lake Nakuru NP **Western Region:** **Kapsetai:** One local guide.
Identify bat species of conservation concern			yes	This objective was achieved by compiling a detailed species checklist for each cave, cross-referenced with IUCN Red List assessments and endemism data. Species of conservation

				concern, including Endangered Taphozous *hildergadae, Otomops harrisoni* (VU), *Rhinolophus deckenii* (NT), *Macroncteris vittata* (NT)were recorded, highlighting the ecological significance of the surveyed roosts and the need for targeted conservation efforts. This study recorded a total of 24 bat species from 11 families roosting in the selected underground caves. The families *Rhinolophidae*, *Miniopteridae*, and *Emballonuridae* were the most species-rich and widely distributed among the caves. The number of caves occupied per species ranged from 1 to 7. The species *Miniopterus spp.* occupied the highest number of caves (7), followed by *Macronycteris vittata*, *Triaenops afer*, *Taphozous hildegardeae*, and *Miniopterus africanus* each occupying 6 caves. Bat species such as *Rousettus aegyptiacus* and *Cloetis percivali* were restricted to a single cave. **Species Richness Comparison Across Regions** Species richness varied notably across regions. The **Southeastern/Coastal region**—comprising Mdenyenye, Kisimani, Mwanangoto, Shimoni Slave Cave, Makuruhu, Kaboga, Guano Cave, and Kisula Caves—generally exhibited high richness, with most caves hosting between 5 and 8 species. Mdenyenye and Kisimani had the highest richness in this region with 8 species each, while Guano Cave recorded the lowest in the region with only 3 species. Kisula Caves had moderate richness with 6 species. In the **Rift Valley region**—including Lionhill, Maumau, and Mt. Suswa—species richness was also relatively high. Lionhill Cave had the highest overall richness of 9 species, followed by Mt. Suswa with 7 species and Maumau with 5 species. The **Western region**, represented solely by **Kapsetai Cave**, had the lowest richness overall, with only 3 species recorded.

				Species richness did not differ significantly between protected and unprotected caves. The mean species richness for protected caves was 6.0 (n = 5), while unprotected caves had a slightly higher mean richness of 6.57 (n = 7). No endemic species to Kenya was recorded Bat population estimates for each bat species recorded were obtained from Dr. Paul Webala (unpublished data). We intend to archive the final call library from the echolocation calls recorded, in a suitable regional repository. This will ensure the data are available for future research, species monitoring, and conservation planning in Kenya.
To develop a Bat Cave Vulnerability Index for the select caves			Yes	The BCVI was successfully developed by integrating biotic and abiotic factors, including species data (richness, threat status) and landscape variables (e.g., proximity to urban centres). The index allowed for effective ranking of caves based on their vulnerability and conservation priority, offering a practical tool for stakeholders and land managers to inform cave protection and management strategies. The results of the Bat Cave Vulnerability Index (BCVI) have not yet been shared, as I am still finalizing the report and preparing the manuscript. However, we plan to disseminate the findings to relevant local authorities, conservation stakeholders, and bat-focused NGOs upon completion.
Identify and map priority cave roosts in Kenya			yes	This objective was fulfilled through field assessments and GIS-based mapping of 12 caves across the three regions in Kenya. Generated maps showing a 300m buffer zone around each cave indicating land use types. This provides a spatial framework for conservation planning and cave protection.

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

a) Development of a Bat Cave Vulnerability Index (BCVI):
The project successfully produced a novel index combining biotic and abiotic indicators to rank caves based on conservation priority. This tool is now available for guiding decision-making and prioritizing cave protection in Kenya**.**

b). Identification of species of conservation concern and priority roosts: Through field surveys, the project documented bat diversity in 12 caves and identified caves hosting threatened species. This directly contributes to species conservation by highlighting key roosting sites.

c). Using GIS, bat roost locations were mapped and analysed in relation to surrounding land use. The resulting maps and spatial datasets provide essential insights for policy development and habitat management.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.
One challenge was limited accessibility to certain caves due to landowner restrictions or cultural sensitivities. To overcome this, the team engaged early with local leaders and landowners, explaining the goals and benefits of the research. Additionally, unpredictable weather at coastal sites occasionally disrupted field schedules, which were adjusted accordingly.

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

Local communities were engaged through meetings, informal interviews, and guided awareness sessions. One brief awareness session was held at each study site(12 sites), focusing on the ecological importance of bats, local threats to cave habitats (such as unregulated guano extraction and unregulated tourism), the value of conserving roosts, and gathering local perceptions about bats. These sessions were informal and involved engaging with whoever was available nearby, rather than through structured workshops. Interactions were brief and took the form of casual conversations.
Community members provided traditional knowledge about caves and helped identify key roosting sites. The project raised awareness about the ecological role of bats and the need to conserve cave habitats. As a result, several communities expressed interest in conserving bat habitats and regulating harmful cave uses such as unregulated guano extraction and unregulated tourism.

5. Are there any plans to continue this work?
Yes. There are clear plans to continue this work by further developing and applying the Bat Cave Vulnerability Index (BCVI) to additional caves across other regions of Kenya. Expanding the index will allow for a more comprehensive assessment of cave roosts at a national scale, supporting better-informed conservation decisions.

As a follow-up to this project, I intend to apply for a **Second Rufford Small Grant** to support this next phase. The follow-up project will build on the current findings by including new sites, incorporating additional ecological variables, and strengthening collaboration with local communities and conservation authorities. This continuity will enhance the long-term impact and sustainability of bat cave conservation efforts in Kenya.

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

- A peer-reviewed publication currently under preparation.
- Presentations at academic and conservation conferences
- Summary reports shared with local authorities and stakeholders
- Outreach materials (posters, flyers) designed for local communities
- Online platforms and networks

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

The first and most important next step is to expand the Bat Cave Vulnerability Index (BCVI) framework to other regions in Kenya. This will allow for the compilation of a **national-scale BCVI**, which can serve as a powerful tool to guide conservation priorities for cave-roosting bats across the country. Given that this is the **first-ever index of its kind applied to Kenyan caves**, scaling it up is essential for identifying and protecting key roosts under increasing anthropogenic pressure.
Additional steps include advocating for policy support to protect high-priority caves, engaging more local communities in cave stewardship, and integrating long-term monitoring to track changes in cave conditions and bat populations over time.

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?

Yes. The Rufford Foundation logo was prominently featured on various project materials, including fieldwork t-shirts (10), reusable water bottles (10), and data sheets. These items, which were funded personally by the project lead, were not part of the official project budget but were created to enhance field visibility and community engagement. They were also shared with local community members, who expressed appreciation for the gesture and the visible support of the Rufford Foundation.

9. Provide a full list of all the members of your team and their role in the project.
Millicent Bungei – Project Leader: fieldwork coordination, data analysis, and reporting.
Sharon Kimeli – Assisted in data collection and stakeholder engagement.

Juma Mwadarusi – Supported cave access, local navigation, and community liaison

10. Any other comments?

I, together with the team, I am grateful to The Rufford Foundation for the generous support that made this important work possible. The funding enabled us to conduct fieldwork, engage local communities, and develop the Bat Cave Vulnerability Index—a first for Kenya. We deeply appreciate the Foundation's commitment to conservation and look forward to building on this foundation in future work.