

Final Evaluation Report

We ask all grant recipients to complete a project evaluation that helps us to gauge the success of your project. This must be sent in **MS Word and not PDF 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 – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please DO NOT fill in and submit this form until the project has been completed.

Complete the form in English. Note that the information may be edited before posting on our website.

Please email this report to jane@rufford.org.

Your Details	
Full Name	Gerald Eyamtenga Osuka
Project Title	Vulture–Electrocution Risk Assessment Survey Along Naivasha–Nakuru Power Distribution Line in Nakuru Wildlife Conservancy, Kenya
Application ID	37076-1
Date of this Report	26 November 2025

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
Quantify vulture mortalities caused by electrical infrastructure		✓		<p>Extensive surveys were conducted, but carcass detectability was extremely low due to rapid scavenger removal and high carcass offtake. This made direct mortality quantification unreliable.</p> <p>A total of three transects were established within Hells Gate National Park: one impacted transect running directly beneath and immediately adjacent to the overhead power line corridor, and two non-impacted (control) transects on either side of the impacted transect, each at least 100 metres from the nearest power infrastructure. Sampling plots measuring 30 m × 30 m were established at 100 m intervals along each transect. A total of 60 sampling plots were assessed across both seasons combined, with 30 plots per treatment category (15 impacted and 15 control per season). All surveys were completed across two full seasons (dry and wet seasons), yielding a fully repeated measures design across seasons. The study employed a rigorous sampling design totalling 120 hours of actual observation time. All ecological surveys, including bird point counts, vegetation assessments, and carcass searches, were conducted on foot.</p> <p>Expert informants participating in the KIs, particularly government/planning,</p>

				<p>power systems, and conservation groups personnel, provided important supplementary information on the spatial extent and configuration of the power line corridor that contextualised the transect placement decisions.</p> <p>Despite repeated and systematic carcass searches conducted on foot along all three transects across both survey seasons, the total number of confirmed bird carcasses attributable to power line electrocution or collision was zero. Two carcasses were encountered incidentally during the survey period, but neither could be attributed to power line mortality: one bore signs consistent with predation, and the other was in an advanced state of decomposition that precluded determination of cause of death.</p> <p>This finding was strikingly consistent with the accounts provided by expert informants during the KIs. Nine of the 13 expert role categories referenced observed collision and electrocution incidents in the broader region, confirming that these mortality events do occur and are witnessed by practitioners, rangers, and conservationists working along power line corridors in the Rift Valley. However, the same informants unanimously described the rapid and near-complete removal of carcasses as a major surveillance challenge (one noted that bird carcasses are usually removed within hours of mortality by jackals, hyenas, and other scavengers).</p>
Determine the factors that			✓	We identified a comprehensive set of factors affecting vulture and raptor

<p>affect vulture electrocution risk</p>				<p>electrocution and collision risk, spanning infrastructure design, ecological and behavioural dynamics, habitat conditions and governance contexts. However, insufficient carcass data limited statistical modelling; this led to methodological realignment.</p> <p>Infrastructure design factors included: uninsulated conductor connectors, insufficient phase-to-phase spacing, unmodified flat-top pole architecture, absence of line markers and proximity to cliff habitats.</p> <p>Ecological and behavioural factors: Dry season concentrations of raptors, migration peak vulnerability (April and October, breeding season flight activity and geothermal thermal plumes.</p> <p>Habitat and vegetation factors: canopy cover reductions and structural simplification, and invasive species encroachment.</p> <p>Governance and institutional factors: late ecological integration in planning, inconsistent maintenance scheduling and weak post-construction monitoring.</p>
<p>Evaluate the effectiveness of existing mitigation devices</p>			<p>✓</p>	<p>Field observations showed inconsistency in mitigation quality, but sample size of vulture incidents was too low for robust chi-square analysis as originally planned; this also led to methodological realignment.</p> <p>Mitigation measures that were identified during fieldwork include:</p> <p>Technical infrastructure measures: bird</p>

			<p>flight diverters on selected conductor spans, insulation of energised components, modified pole top configurations with a limited number of poles retrofitted with wider crossarm configurations, perch discouragers.</p> <p>Operational and ecological measures: vegetation management timing adjustments, with maintenance teams voluntarily delaying vegetation clearing in specific corridor sections to avoid active nesting periods following communication with KWS rangers or community scouts. However, these adjustments are discretionary rather than systematic.</p> <p>Deployment of these measures was found to be inconsistent and patchy rather than systematic: current mitigation is reactive, site-specific, and insufficiently comprehensive to prevent the significant vegetation structural change and avian community compositional reorganisation detected across the surveyed corridor.</p>
<p>Additional Note: Due to limited carcass recoveries and emerging insights during early fieldwork, the project pivoted—ethically and scientifically—to a broader scientific research design evaluating ecological impacts of power infrastructure corridors, integrating vegetation, avian, and expert perspectives. This allowed the project to produce rigorous, defensible outputs rather than relying on extremely low mortality sample sizes.</p>			

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

a). A revised and successful ecological study producing robust, publishable results:

Transitioning from carcass-based mortality estimation to a more comprehensive ecological-impact approach yielded strong quantitative and qualitative findings. In summary, these revealed that powerline corridors significantly affect vegetation

structure and avian species composition, even when direct mortality is rare or undetectable.

More specifically, Using vegetation surveys, avian community sampling, and PERMANOVA/LMM analysis, the project demonstrated that overhead power corridors:

- Significantly reduce vegetation structure (canopy cover & tree density).
- Alter avian species composition, even when abundance and Shannon diversity remain unchanged.
- Act as ecological filters, favouring open-habitat generalists over canopy-dependent species.

This represents a major conservation insight, directly relevant for energy–biodiversity planning in Kenya.

b). First integrated assessment linking power-line management policy and ecological outcomes in Kenya:

Through Key Informant Interviews (KIIs) with 15 experts (5 each from Government/Planning, Power Systems, and Conservation groups), the project demonstrated that policy ambiguity and inconsistent vegetation clearing (corridor maintenance) practices are the primary drivers of ecological change—an insight not previously documented for this region.

The results revealed that there is actually:

- Fragmented policy and regulatory frameworks for power-line management
- Irregular or poorly timed vegetation clearing (corridor maintenance) schedules
- Weak or absent monitoring of mitigation devices

This produced a strong conceptual link between governance deficiencies and biological outcomes, filling a major knowledge gap.

c). Actionable, evidence-based, and stakeholder-informed recommendations

The project produced actionable recommendations:

- Shifting corridor maintenance to non-breeding/dry seasons
- Moving from blanket vegetation removal to selective, species-appropriate clearing
- Mandating long-term monitoring of bird–powerline interactions
- Integrating ecological trade-off analysis in EIAs

These outputs equip managers with practical tools for reducing biodiversity impacts while maintaining power-system safety.

The recommendations arising from this project span three domains, namely infrastructure planning and design, operational maintenance, and policy and governance, and will be shared through targeted channels reaching practitioners, regulators, and the scientific community.

Engagement Already Initiated

- Kenya Wildlife Service (KWS): KWS rangers and headquarters staff were engaged throughout the fieldwork period through the survey process and KII participation. KWS informants contributed directly to the findings on observed avian impacts, seasonal vulnerability, and successful collaborative models within the park. Preliminary findings were shared verbally with KWS personnel at Hells Gate National Park, and a formal report sent to KWS Headquarters and WRTI, whereas formal presentations are planned as part of the stakeholder dissemination programme with both parties.
- Power Systems Personnel: Engineers and operational staff from all power organisations participated as KII informants, and the interview process itself served as an initial knowledge-exchange opportunity in which the study's emerging findings on vegetation structural change and avian compositional shifts were discussed. These organisations represent the most direct operational recipients of the design, maintenance, and monitoring recommendations.
- Egerton University: A departmental seminar presenting the preliminary project findings, including the quantitative ecological results and the qualitative governance analysis, was delivered to the Department of Natural Resources at Egerton University. This session engaged a diverse audience of faculty and postgraduate students to refine the study's methodologies. Furthermore, the final thesis defense and presentations at scheduled scientific conferences are slated for the coming months to ensure the broader dissemination of these findings to the scientific community and conservation practitioners.
- NEMA and Ministry of Environment informants: Government officials from NEMA and the Ministry of Environment who participated as KII informants were introduced to the study's findings on ecological integration timing and the limitations of current EIA processes in capturing avian community compositional effects. These informants expressed interest in the policy recommendations and indicated their relevance to ongoing reviews of EIA guidelines for energy infrastructure.

Planned Dissemination

- Scientific publications: Two manuscripts are currently in the correction phase after submission to peer-reviewed journals. One will report the quantitative

ecological findings, while the second will address methodological lessons including carcass detectability constraints in African savannah systems. Both manuscripts will be shared with all KII participants upon acceptance.

- MSc thesis submission: The full thesis will be submitted to Egerton University and made available through the university repository. Copies will be provided directly to all relevant organizational stakeholder as a comprehensive technical reference.
- Policy brief: A concise policy brief targeted at energy sector and conservation stakeholders will translate the study's recommendations into actionable language accessible to non-specialist readers. This brief will be distributed to NEMA, the Ministry of Energy, the Ministry of Environment, KWS, and the National Museums of Kenya (NMK) ornithology department.
- National and regional conference presentations: At least two conference presentations are planned for 2026, targeting national conservation events and regional ornithological or energy-wildlife interaction forums. Both quantitative findings and qualitative governance insights from the KIIs will be presented.
- Wildlife Research and Training Institute (WRTI): As the primary institution for wildlife management training in Kenya, WRTI will be engaged as a partner for the biodiversity training recommendations directed at maintenance field staff.
- Rufford Foundation network: All outputs will acknowledge the Rufford Foundation, and a project summary will be made available through Rufford's online database for the benefit of future small-grant researchers undertaking similar work in East Africa and comparable landscapes.

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

The project encountered several unforeseen challenges spanning administrative, logistical, and ecological dimensions.

First, institutional and regulatory delays significantly affected early timelines. Obtaining signed imprests – required for the disbursement of project funds – in time, and processing the required internal approvals took much longer than anticipated. Fieldwork permits and regulatory clearances were also delayed due to slow administrative turnover. These hurdles were mitigated by initiating documentation well in advance, maintaining continuous communication with institutional offices, doing constant regular follow-ups and adjusting field schedules to accommodate extended approval lead times.

Second, the principal ecological difficulty was the near-total absence of detectable carcasses along the powerline transects. Even with repeated, systematic surveys, carcass detection remained extremely low due to several factors:

- very rapid removal by scavengers such as jackals, hyenas, and raptors;

- human offtake, especially by pastoralists and herders;
- dense vegetation in certain segments that reduced visibility;
- the logistical difficulty of continuous daily patrols over long distances.

Despite consistent effort, carcass sample sizes remained far below what was required for any mortality estimation model or risk-stratified statistical analysis. This made the original vulture–electrocution objectives scientifically unfeasible.

To preserve the integrity and value of the project, an adaptive redesign was implemented early in consultation with supervisors and stakeholders. The project pivoted from carcass-based mortality inference to a more integrative, ecologically robust scientific research framework that remained aligned with conservation and infrastructure-management priorities. The redesign replaced direct mortality estimation with:

- vegetation structure and species composition surveys;
- avian abundance, diversity, and multivariate community analysis (NMDS, PERMANOVA);
- structured Key Informant Interviews with experts to contextualize ecological patterns and management challenges.

This integrated design produced a much stronger evidence base and ensured that donor funds generated meaningful, publishable results despite methodological constraints.

Lastly, seasonal and access-related challenges arose during fieldwork. Wet-season mainly led restricted movement in certain transects, and some routes became temporarily inaccessible. These constraints were mitigated through drone-assisted reconnaissance, rerouting of transects, and reliance on qualitative interviews during periods of limited mobility.

Overall, despite substantial administrative, logistical, and ecological obstacles, the project adapted effectively, allowing it to meet its conservation objectives and generate high-quality scientific outputs.

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

Local communities and stakeholders played an integral role throughout the project. Engagement included community leaders, landowners, local rangers, youth groups, and community-linked conservation staff. These groups provided essential logistical guidance on access routes, land-use patterns, and areas where human activity or livestock movements could influence wildlife detection. Their local knowledge also helped identify potential conflict hotspots and sites of ecological concern.

Three different local community members served as field assistants and guides on each survey day across both the dry and wet season periods. These individuals were drawn from communities bordering Hells Gate National Park, including pastoral and agropastoral households with long-standing familiarity with the landscape, wildlife movement corridors, and seasonal dynamics of the survey area. Their contributions included navigating access routes, identifying areas of potential ecological significance, providing real-time alerts to wildlife presence during point counts, and assisting with equipment transport along transects. Over the full duration of fieldwork spanning both seasons, approximately 8 to 10 distinct community members were engaged in field support roles on a rotational basis. Two KWS rangers occasionally accompanied us on a rotational basis during the survey period.

In addition to ecological surveys, community engagement occurred through informal discussions and targeted Key Informant Interviews with local conservationists, pastoral representatives, and Kenya Wildlife Service (KWS) personnel. These interactions provided important context on powerline maintenance practices, bird-powerline interactions, and community perceptions of powerline impacts. Local youth and rangers also assisted in field navigation, gaining hands-on experience with ecological monitoring techniques.

In total, approximately 15 to 20 community members were directly involved in or present during formal survey activities, inclusive of field assistants, guides, and KWS rangers. A broader group of community members, estimated at a further 10 to 15 individuals, participated in informal discussions and engagement activities throughout the fieldwork period, bringing the total community contact to approximately 25 to 35 individuals over the full project duration.

Benefits to local communities included:

- Increased understanding of bird–powerline risks and the ecological role of raptors and vultures
- Awareness of how poorly timed or poorly executed vegetation clearing can affect wildlife and ecosystem health
- Strengthened relationships between communities, conservancy staff, KWS, and power-line operators
- Transfer of practical field skills related to ecological monitoring and safe incident reporting

Overall, these collaborative engagements helped build local stewardship for wildlife safety around power infrastructure and created a foundation for continued community–agency cooperation in the future.

5. Are there any plans to continue this work?

Yes. Two major follow-up initiatives are planned:

1. **A PhD-level research programme** that will deploy real-time monitoring technologies—such as automated cameras, sensor networks, and AI-assisted detection tools—to evaluate bird–powerline interactions (collisions and electrocutions) and quantify their ecological consequences, particularly on raptor breeding success.
2. **A seasonally structured field experiment** comparing selective vegetation management with conventional blanket clearing practices during powerline maintenance. This work will assess how different clearing strategies influence habitat structure, avian community composition, and ecological recovery.

In addition, we are exploring opportunities for continued knowledge sharing through workshops and presentations with Egerton University, Kenya Wildlife Service (KWS), Kenya Electricity Transmission Company (KETRACO), Wildlife Research and Training Institute (WRTI), and conservancy management teams.

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

We are exploring opportunities for continued knowledge sharing through workshops and presentations with Egerton University, Kenya Wildlife Service (KWS), Kenya Electricity Transmission Company (KETRACO), Kenya Electricity Generating Company PLC (KenGen), Wildlife Research and Training Institute (WRTI), and other conservation management teams like National Museums of Kenya (NMK) – ornithology department. Planned dissemination pathways include both academic and stakeholder-focused outputs to ensure that the findings reach practitioners, policy actors, and the scientific community.

Academic outputs will include:

- Submission of my MSc thesis to Egerton University, accompanied by departmental seminars presenting project findings.
- Two scientific manuscripts, currently submitted for review.
- At least two conference presentations at upcoming national and regional conservation events in 2026.

Stakeholder and public-facing dissemination will involve:

- Presentations to KWS, KETRACO, National Museums of Kenya, and the Hells Gate community representatives, highlighting implications of overhead power lines on avian ecology.
- A policy brief targeting Kenyan conservation and energy-sector stakeholders.

- Articles for Kenyan environmental communication platforms and practitioner networks, summarizing key recommendations in an accessible form.
- Engagement with the IUCN SSC Vulture Specialist Group: will initiate contact with the VSG Secretariat to introduce the project, share a summary of findings, and explore opportunities for collaborative engagement, including the possibility of contributing to VSG working group discussions on power line mortality in Africa or presenting findings through a VSG webinar or newsletter feature.
- BirdLife International Africa Partnership and African Raptor Databank: With the help of my supervisors, we will explore whether the species-specific risk factor data and the avian compositional findings from this project can contribute to the African Raptor Databank or be highlighted through BirdLife's Africa Partnership programme, which coordinates IBA monitoring and infrastructure impact documentation across the continent.
- African Raptor Conference and regional forums: We will investigate the possibility of presenting project findings at the next African Raptor Conference or an equivalent regional forum that reaches vulture and raptor conservation practitioners across sub-Saharan Africa.

The Rufford Foundation will be acknowledged in all scientific and non-scientific outputs arising from this work.

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

- Long-term monitoring of avian species composition and vegetation structure along expanding electrical networks.
- Experimental testing of season-specific and selective vegetation management, as recommended in the study.
- Species-specific mortality surveillance, using real-time monitoring technologies that will help effectively outdo rapid carcass removal rates by predators and scavengers before quantification.
- Policy harmonisation, ensuring that infrastructure planning incorporates ecological design standards.

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 incorporated into all project documentation, communication materials, and field presentation slides delivered at Egerton University, the Wildlife Research and Training Institute (WRTI), and Kenya Wildlife Service (KWS) Headquarters. The Foundation was also explicitly acknowledged during stakeholder meetings and verbal briefings with KWS and Hell's Gate National Park teams, as well as in discussions with graduate students in the Department of

Natural Resources at Egerton University. Rufford Foundation will continue to be credited in all forthcoming scientific publications, presentations, and outreach materials arising from this work.

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

- **Gerald Eyamtenga Osuka** – Principal Investigator; coordination, fieldwork, data collection, analysis, reporting
- **Dr. Wilfred Odadi** – Principal Supervisor; scientific oversight and technical guidance
- **Dr. Maurice Ogoma** – Second Supervisor; scientific oversight and technical guidance
- **KWS Rangers** – Field logistics and field support
- **KETRACO, KENGEN, & KPLC Personnel** – Technical insights on infrastructure management
- **Local community leaders and guides** – Contextual insights into land-use and wildlife interactions

10. Any other comments?

I am sincerely grateful to the Rufford Foundation for the flexibility and support that allowed this project to evolve in design while retaining strong scientific integrity and conservation relevance. The necessary shift from carcass-based electrocution surveys to a broader ecological assessment of vegetation, avian communities, and policy contexts ultimately strengthened the project's impact. Rather than yielding limited mortality data, the revised approach produced the first integrated vegetation–avian–policy analysis of overhead power infrastructure in this region, offering insights of direct value to power-line managers, conservation agencies, and national planners.

The Rufford Small Grant was instrumental in enabling this expanded, evidence-based assessment and in building a robust scientific foundation that will inform both academic publications and practical conservation interventions moving forward.

ANNEX – Financial Report
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