

Final Evaluation Report

Your Details	
Full Name	Aisha Uduman
Project Title	From conflict to coexistence: Investigating drivers of leopard-livestock conflict and suitable cattle husbandry techniques to enable coexistence in Sri Lanka
Application ID	24740-1
Grant Amount	5000 GBP
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Date of this Report	February 16 th 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
Quantitative ecological study measuring leopard native prey abundance				Camera traps were set up throughout the Yala buffer zone region with the permission and supervision of the Department of Wildlife Conservation, and images were analysed to calculate prey biomass availability at each camera site.
Community forum in each farming community				This was more successful in the Central Hills, where estates are well managed and have a hierarchy of management. In Yala, there are no 'managers' to help facilitate such a forum, however we organized three forums where over 20 farmers attended. Preliminary results were shared, with potential mitigation techniques proposed in order to solicit feedback and local insights that can be applied before any trialling were to take place.
Household surveys and semi-structured interviews				A total of 112 surveys were completed and translated between the two regions, and interviews ranging in length that provided a wealth of information to be used in subsequent analysis.
Extracting habitat variables from GIS layers to be used in regression modelling				Habitat variables were extracted using Google Earth, as it provided finer resolution than the available GIS layers in order to extract the variables needed for analysis. Features such as distance to water, distance to forest patch, forest density and distance to road were extracted and used in Generalised Linear Models (GLMs).
Data analysis using generalised linear mixed models				The data analysis went through many iterations. For the interview data evaluating community attitudes towards leopards, Exploratory Factor Analysis was performed (on both the explanatory and predictor variables) and GLMs were then run on the resulting variables obtained.

			<p>For the second set of models looking at potential drivers of cattle depredation in Yala, we used GLMs to test the importance of hypothesised explanatory variables, specifically: native prey availability, cattle husbandry, number of cattle, distance from national park, road density and pastoralist (farmer) residency time.</p>
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2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.

Delays in obtaining the appropriate permit required to set up cameras in the buffer zone (which is under purview of the Department of Wildlife Conservation) occurred, which set us back in terms of time available to collect data and start the image analysis process. Despite our best efforts to mitigate theft (and checking the cameras daily while in Yala), many camera traps were stolen/broken, including the SD cards with images on them. This ultimately reduced the number of camera trap stations with usable data to 28 in total and affected the distribution of these cameras in relation to the cattle farms across the surveyed region. We tried to account for this by evaluating habitat variables around each camera trap station in order to extrapolate leopard prey estimates to cattle farms with similar habitat metrics.

Delays in data processing occurred as the software used to analyse camera trap images had to be switched due to extremely low speeds (and high number of photos). In addition, the data that was shared with me had to be re-analysed (which we didn't anticipate for) upon the discovery of some errors in processing. This added a few months of time which was otherwise unforeseen.

Difficulties arose when analysing the survey data and running Exploratory Factor Analysis on specific subsections of data. This is a part of the analysis that was unexpected, but which will add great value to the outcome and interpretation of the survey results. It took a couple of months to learn and understand the logic behind Factor Analysis and Structural Equation Modelling, which was an unanticipated part of this analysis, but after consulting with an expert in social science statistics, it was determined that the most value from the data could be obtained through using this method.

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

- Survey results indicate promise for coexistence between livestock farmers and leopards in the Yala buffer zone region. 80% of farmers interviewed stated that leopards are the biggest issues they face rearing livestock in that region, yet 84% of them are interested and desire their conservation. This, along with other metrics measured in the surveys, indicate a willingness to coexist with leopards, which should be harnessed when promoting any new mitigations or husbandry techniques that can reduce livestock losses.

- Modelling results found evidence to support two of our initial hypotheses: depredation levels decreased with improved livestock husbandry and increased with increasing livestock numbers. All other covariate effects had confidence intervals that overlapped zero and are therefore not statistically significant. The top-ranked model included husbandry score (-0.607, 95% CI [-0.836, -0.390]) and number of cattle (0.403, 95% CI [0.251, 0.564]). The adjusted R2 value for this model was 0.60, with 45% of deviance explained.

The way in which cattle are kept dictate how easily accessible they are to leopards (e.g., whether a steel pen is being used versus barbed wire and thorn bushes, which leopards may easily overcome). This result points towards a need to focus on husbandry techniques, as this is tied to human behaviour and actions that can be changed easily, given the resources. Easy tactics such as preventing overcrowding of pens, or trialling light and sound mitigations might be next steps in this line of work. Both of these options (with specific examples used in other countries successfully, e.g., Foxlight) were presented at the Yala and Central Hills community forums, as appropriate and were met with general support. Potential barriers/shortcomings of the light and sound mitigations in particular were brought to our attention in Yala, based on the farmers knowledge of leopard behaviour.

- In the Central Hills, no cattle were found to be lost due to depredation incidents. However, a leading cause of death in this region was disease and miscarriages, largely due to the difficulty in bringing veterinarians up to the tea estates (located in high elevations, on tea estates in extremely poor and difficult roads) as well as hypothermia. In Yala as well, disease was a sizeable cause of cattle death, and this points towards focusing energy and funds towards programmes that can facilitate greater veterinary/preventative medical (e.g., vaccines) services to prevent this form of cattle death. Semi-structured interviews and the community forums in both sites presented opportunities to explore options such as government funds/a farmer pool of money to bring veterinarians to the region (especially tea estates, where one estate will have 8-10 cattle owners within walking distance to each other) in order to provide vaccinations and treatment to large groups of cattle at a time, as opposed to one individual farmer and their cattle. This was met with more support in the Central Hills than in Yala, likely due to the feasibility and the structure of the tea estate system which is lacking in Yala. Farmers in Yala expressed the need for proactive veterinary service but many are unable to provide this consistently on their own.

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.

It was a key goal for local communities to be involved throughout this project, as the livestock-rearing communities are ultimately the ones affected any conflict that arises with leopards. During the initial pre-survey phase, we got to know the area

and spoke to local livestock owners about general issues and problems they faced rearing livestock in the area. Members of the community itself were used to assist with the project, through setting up further interviews to transport and assisting with translations. The responses of community members will benefit them as the results and presentations that will arise from this work will be directed back towards the community, and any mitigations that are deemed feasible will be promoted and recommended to be tested in the future. These will, in the long term, act to reduce livestock losses and will help safeguard the livelihoods of many community members in the affected regions.

6. Are there any plans to continue this work?

Yes – it is my intention to return to the Yala region to trial some cost-effective and feasible light and sound mitigations. The COVID-19 pandemic has affected my ability to return to Sri Lanka, but it is my hope to do so when I am able. New mitigations to be tested will need to be approved by the Department of Wildlife Conservation, and I hope that the Wilderness and Wildlife Conservation Trust will continue this work given my findings and reports produced, as they are based in Sri Lanka and plan to increase the scope of their work in the Yala buffer zone region.

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

One major goal was to hold a meeting with the Sri Lankan dairy farmers that were interviewed and share the results as well as present various options that seem feasible for mitigating livestock losses. These options will be derived from literature combined with insight from the interviews. It is important to gauge community response to these options to plan future directions, and which techniques have the support of the community to try implementing. This was done successfully in the Yala region. In the Central Hills, this was done within each separate tea estate where the discussions were focused more on what is needed in terms of veterinary and infrastructure improvements, as no depredation of cattle had occurred at the time of this study.

My MSc was defended successfully in December 2019, and my MSc thesis is available online

(<https://open.library.ubc.ca/soa/cIRcle/collections/ubctheses/24/items/1.0387338?o=0>). As of February 2022, it has been viewed 1087 times and downloaded 137 times from regions all over the world. Two manuscripts are intended to be published in peer-reviewed journals. One was published recently (January 2022) in *Oryx*, focussing on community attitudes towards leopards in both Yala and the Central Hills: <https://doi.org/10.1017/S0030605321000247>. The other is in the submission process and will hopefully be published later this year, focused on the ecological drivers of leopard-livestock depredation in the Yala buffer zone region.

I have attended and presented at four academic conferences: The Pacific Ecology and Evolution Conference, and the British Columbia Chapter of The Wildlife Society Conference, The International Congress for Conservation Biology and the Association for Tropical Biology and Conservation and shared my project and results.

This work has also been shared in smaller formats/presentations made to local Sri Lankan groups (environmental consultancies, eco-tourism operators, etc).

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

The grant was awarded in April 2018 and the funds were used throughout the field season from April – August 2018. A second field season was scheduled for June-August 2019 which was not anticipated earlier on, due to high rates of camera theft and data gaps which, as far as possible due to time and budget constraints, need to be filled. I had anticipated a finish date of August 2019; however this was pushed back by an extra academic term due to a second field season.

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
Camera traps	3350	1780	-1570	A different model of camera traps was purchased – Bushnell Trophy Cam Essential E3. In addition to the cameras, locks and SD cards were also purchased which were not included in the original budget and amounted to approximately 336 GBP (locks) and 270 GBP (SD cards)
Field assistant salary	866	1428	+562	The local salary rate was higher (35,000 LKR/month instead of 25,000) due to increased cost of living and prices of rent and groceries. Cost is for field assistants for both field seasons (2018 and 2019).
Vehicle costs	732	1792	+1060	Renting a vehicle was not feasible and costs were much higher than advertised online. I ended up paying a daily rate for transport (LKR 4500, or 20 GBP), including a driver, around the study sites, on top of bus transport to and from the study sites from Colombo.

				Costs are for both field seasons (2018 and 2019). Expenses exceeded the grant amount and funds from other sources were used towards transportation.
Gasoline	52		-52	As mentioned above, we did not rent a vehicle but paid a daily rate for a driver instead.
TOTAL	5000	5000		

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

Maintaining a relationship with the Wilderness and Wildlife Conservation Trust, I hope to continue to be involved in this work. I'm excited to pursue opportunities for collaboration with government, industry, NGOs and other academics to pool together knowledge and funds in order to address this issue.

After this work is complete, an important next step would be to actually test some mitigation technologies/strategies to gauge their effectiveness in the local context. Some options are: Foxlights, herder presence, structural changes to cattle pens, and changes to herding practices, especially free-grazing close to forest borders. This project may give the foundation to see which mitigations are supported by the community, but the testing and monitoring of any mitigations is beyond the scope and timeline. Mitigations that are both effective and supported by the community, and that have plans in place for their long-term monitoring, are an important next step in order to prevent this conflict from escalating beyond our control.

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?

The Rufford Foundation logo was used in all academic conference presentations and posters. The Rufford Foundation has been acknowledged in my MSc thesis and will be acknowledged in any peer-reviewed articles that arise from this work, as it has been in my first peer-reviewed publication to come out of this work: <https://doi.org/10.1017/S0030605321000247>

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

Dr. Cole Burton – MSc Co-Supervisor, provided analytical insight and project development assistance. Provided comments on proposals. Provided funds to attend conferences and camera traps to be used in Sri Lanka for the second round of fieldwork.

Dr. Andrew Kittle – MSc Co-Supervisor, provided survey feedback and local knowledge during the field season. Provided comments on proposals.

Dr. Shannon Hagerman – Committee Member, provided analytical insight regarding the survey design and analysis. Provided feedback on proposals.

Dr. Edward Kroc – Provided analytical support with Exploratory Factor Analysis and helping to structure the modelling analysis of the survey results.

Al-fayed Mohammed – Provided assistance in the field during camera set-up and conducted community interviews in Sinhala language. Helped to analyse interviews and interpret key findings.

Parami Pieris – Provided assistance in the field during the field season in 2019 with camera trap set-up, community forums and discussions on future mitigation methods to trial. Also provided assistance in extracting habitat variables from Google Earth.

13. Any other comments?

I would like to extend a huge thank you to The Rufford Foundation for giving a sizeable grant to fund a huge portion of this work. Without this funding, the project would not have been possible. It is my hope that the results and methods used to tie together social and ecological sciences can help inform how we approach human-wildlife conflict in Sri Lanka as well as other regions, and ways to coexist with the wildlife around us.