

The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other 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. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Vivek Thuppil
Project title	Experimental Mitigation of Crop-Raiding by Asian Elephants (<i>Elephas maximus</i>) Using Low Cost Predator-Mimicking Sound Playback Devices
RSG reference	10201-1
Reporting period	September 1, 2011 to August 31, 2012
Amount of grant	£5942
Your email address	vthuppil@gmail.com
Date of this report	February 3, 2013

1. Please 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
Develop a low-cost, low-maintenance predator vocalisation playback device and test its efficacy in mitigating crop-raiding by elephants			X	
Record vocalisations at a large distance from a loud source and play them back at a close distance from a small speaker to imitate a distant predator and deter crop-raiding elephants		X		Vocalizations that were 105 dB sound pressure level (SPL) at 1 m from the source were recorded at a distance of 10 m and then played back to elephants at a distance of 10 m, thus imitating a predator 20 m away. Initial recordings at further than 10 m were too soft when played back to present a credible threat. Similarly, the usage of a smaller speaker did not present a credible threat. For further explanation, please refer to answer to #3 below.
Achieve a major reduction of crop-raiding through our low-cost, low-maintenance predator vocalisation playback devices			X	
Provide increased economic opportunities for local villagers		X		The villagers that I hired during this study were compensated well during the study and benefited economically in that aspect. However, I have not yet implemented a system where they can source, manufacture and market these devices locally. I still hope to make that a reality in the next year.

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

While I initially had thought about recording these threatening vocalisations at a distance of up to 30-50 m and playing them back from a close distance, I instead recorded these sounds at a distance of 10 m from the large speaker for playback from the smaller low-cost speakers. At greater distances, the level of sound attenuation through vegetation had dropped to the point that, when played back from the small speakers, the audio output was too low in intensity to pose any meaningful deterrent. At the 10 m recording distance, the playback sounds from the 25-watt speaker system had an intensity level of 84 dB SPL at a distance of one meter from the speaker. The

apparent sound intensity heard by elephants 8-10 m away was 62-64 dB SPL, which approximates the sound level of the louder speaker system heard at 50 m distance.

Even the usage of the smaller speakers ran into issues. The forest guards said that the larger playback system (used to initially re-record the predator sounds from a distance of 10 m) produced a louder sound and served as a warning signal for them that elephants were nearby. In contrast, the smaller playback system's sound level was often not sufficiently audible to alert forest guards at a distance of nearly 75 m from the device due to the direction the sound was emitted. Additionally, there were concerns that the elephants were not being deterred by the smaller speakers as effectively. These concerns were not without substance.

To compare the effects of various predator sound levels, I compared elephant responses to playbacks of tiger growls from the smaller playback systems producing a playback intensity of 84 dB at a distance of 1 m and the larger playback systems producing a playback intensity of 94 dB at a distance of 1 m. A multinomial log-linear analysis found that the interaction of sound pressure level and running was statistically significant (Figure 5), with a greater frequency of elephants running away from the louder tiger-growl playbacks (likelihood ratio $\chi^2 = 5.989$, $df = 1$, $p = 0.014$). Thus, even in a low-cost system with cheaper sensors and triggering mechanisms, a large, powerful speaker is indispensable in order to present a credible predatory threat and reliably deter elephants.

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

The first major outcome of the project was determining that the strength of the playback sound has a direct bearing on how elephants react. Elephants ran away from the larger playback systems much more frequently and in a statistically reliable manner than they ran away from the smaller playback systems. Elephants did not deliberate after hearing the louder tiger growls and retreated quickly.

The second major outcome of the project was determining that predator sounds could be used to reliably deter crop-raiding by elephants. I tested both tiger growls and lion growls (leopard growls were deemed to be unsuitable as they were tested in a previous study). I examined the frequency of crop-raiding deterrence in contingency tables, with elephant crop-raiding attempts as units of analysis. An elephant crop-raiding attempt might include the same individual elephant on different nights or different elephants on the same night. Multinomial log linear analysis with maximum likelihood estimation revealed that, with 48 distinct elephant attempts, the interaction of playback sounds and frequency of crop-raiding deterrence is not significantly different (likelihood ratio $\chi^2 = 5.253$, $df = 3$, $P = 0.154$). The playbacks prevented crop-raiding 84.6 % of the time using lion growls from the larger playback systems, 87.5 % of the time using tiger growls from the smaller playback systems, 100 % of the time using tiger growls from the smaller playback systems where there was a preceding static buzz and 100 % of the time using tiger growls from the larger playback systems.

While there were no statistically reliable differences in crop-raiding deterrence among the various sound playbacks and all playbacks had crop-raiding deterrence of at least 80 %, I would recommend tiger-growl playbacks from the larger playback system as the most effective playback to use for conflict-mitigation. Total elimination of crop-raiding instances rather than statistical reliability of crop-raiding deterrence should be the goal here, since even a single crop-raiding foray can be devastating in terms of crop losses. Thus, while there was no statistical difference for crop-raiding deterrence between tiger- and lion-growl playbacks, indications are that lion-growl playbacks are

deemed to be slightly less threatening and thus tiger-growl playbacks are likely to be more useful for achieving conservation-oriented goals. It is important to note that the larger playback system when presented in a narrow corridor maintained its efficacy over numerous repeated encounters, thus proving capable of resisting habituation.

The third major outcome of the project was the successful construction of a low-cost playback system. This system was constructed and tested effectively, meaning that there is significant future potential for larger-scale manufacture and retail of an affordable device that could mitigate crop-raiding by elephants.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Assistants hired for this project were young villagers from communities within and immediately adjacent to the forest. They were trained on the assembly and maintenance of these low-cost devices. Employment during the project provided them with a source of income and the knowledge that they obtained will be useful in the future for marketing this device.

At the completion of the project, the devices were left in the locations where they were tested. Local villagers and forest officials were trained on how to maintain the equipment and were provided with additional batteries and solar panels. As of July 2012, four months after the completion of the project, the devices were still operating in these villages.

5. Are there any plans to continue this work?

Towards the end of the project, we approached students from the Sri Jayachamarajendra College of Engineering in Mysore to develop an integrated elephant detection and sound playback mechanism. The device that we tested in the villages was an experimental model and while villagers were trained to change the batteries and keep it in operation, there was the danger of other wires being displaced that would render the device inoperable. The students at SJCE designed, as part of their 6th semester design project, an integrated system with the sensor and playback system which is sealed. At the exterior, there were clearly marked connections for attaching the battery and speaker output wires. We now plan to retrofit the existing playback systems with these devices and allow the villagers to continue testing them. If the villagers are satisfied with this playback system and there is interest in purchasing more, that will provide business opportunities for the assistants employed in this project who will be able to assemble and market such systems.

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

I am sharing the results of this work in numerous ways:

- a. Conferences – I presented a talk on this work at the 4th International Wildlife Management Congress held at Durban, South Africa from July 9-12, 2012. Audience members included both academics and wildlife management officials from around the world.
- b. Academic talks – I presented academic talks on this research at the University of California, Davis and Drexel University, Philadelphia in October 2012 and January 2013 respectively. I

plan to present an academic talk at the Indian Institute of Science, Bangalore in March / April, 2013 as well.

- c. Research blog – I have a research blog at <http://elephantsabout.wordpress.com/> where I've uploaded research videos and descriptions. The purpose of the research blog is to concisely yet effectively enable someone with no previous knowledge about animal behaviour or conservation research to understand the methods and conservation implications of this research. I also have a Facebook page (Elephants About) for the same purpose.
- d. Media coverage – I've received some press coverage about my work through an article published in The Daily Mail in New Delhi, India in June 2012. My research will also soon be highlighted in the "Student Spotlight" section of the web page of the University of California, Davis.
- e. Word of mouth – Villagers as well as my assistants are spreading knowledge about my research to neighbouring villages in the area. Villagers in my study region are familiar with what I've done as a result of this.

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

The RSG was used from September 2011 to March 2012. There was no major difference from the anticipated length of the project.

8. Budget: Please 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.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Salary for field assistants	£2012	£2276.92	+ £264.92	I was able to hire only four qualified assistants instead of five, so I paid them a higher salary rate than initially budgeted. This took me slightly over the total budgeted amount.
Field salary for graduate student researcher	£1890	£1890	- zero -	
Airfare for graduate student researcher	£1200	£855.77	- £344.23	I was able to obtain a cheaper ticket by booking a domestic flight ticket within the U.S. and an international one to India. I used RSGF funds only to cover the international flight ticket.
Diesel fuel for field vehicle	£840	£899.80	+ £59.80	Fuel expenses were slightly higher than initially budgeted
Total	£5942	£5922.49	- £19.51	

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

I've conducted research showing that threatening sounds can be effectively used to keep elephants from crop-raiding and that low-cost devices using this technique can successfully be used to deter elephants repeatedly when used in situations where circumvention of the system is not possible. The next step in this research is to develop a system that can similarly deter elephants over the long term even in locations where circumvention is possible. This can be done by presenting a playback system where the playback location changes to imitate a moving threat rather than a stationary one. Such a system would be resistant to habituation and has the potential to deter crop-raiding virtually anywhere in the world.

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

The RSGF received publicity in the acknowledgement section of all presentations that were made regarding this research in academic talks as well as at the international conference. The RSGF has been specifically highlighted on the research blog as well as a contributor that enabled this research.

11. Any other comments?

I would like to thank the RSGF for providing me this grant, which was critical to my being able to develop and test the low-cost device. It enabled a very integral portion of my research that showed that this technique could be implemented in a practical manner. Thank you once again.