

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	Matthew Becker
Project title	Evaluating a Critically Important but Undescribed Leopard Population in the Luangwa Valley
RSG reference	9844-1
Reporting period	5-Sept-11 through 5-Sept-12
Amount of grant	£5966
Your email address	matt@zambiacarnivores.org ; erosenbl41@gmail.com
Date of this report	22-Sep-12

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
Estimate leopard densities within South Luangwa National Park (SLNP) and in adjoining Game Management Areas (GMA)		X		After further discussion with Zambia Wildlife Authority (ZAWA) researchers we determined that the initial questions about density should be focused on SLNP first and should be followed by a subsequent survey in the adjoining GMA. Consequently we conducted a broader survey in the park and will be conducting the GMA survey at the same time in 2013.
Develop a camera-trap study design that can be adapted for use in other areas of the Luangwa and region for monitoring rare and elusive species in stable, recovering and perturbed ecosystems where the Zambian Carnivore Programme (ZCP) operates.			X	A study design incorporating the most recent techniques and literature on leopard surveys, camera trapping and occupancy modelling was developed after considerable development with peers and collaborators.
Generate good quality photographs for a photo-identification database of individuals that will comprise the basis for long-term studies of leopard populations.			X	A high quality database of leopards as well as a myriad of other large carnivore and meso-carnivore species was developed to serve as the baseline for future study.
Involve community stakeholders such as safari guides, operators, and local secondary school students in the data collection and wildlife methodology.			X	All said stakeholders were significantly involved in a meaningful way.
Train and involve ZAWA Research staff in the design, implementation and analysis of leopard data and integrate this work into their South Luangwa Area			X	Multiple staff from ZAWA's South Luangwa Area Management Unit were involved in the design, data collection and analysis of this study and will be co-authors on the scientific products developed upon completion of the GMA portion of

Management Unit species monitoring plans.				the survey.
Prepare and present a report to ZAWA on the methods, findings, and implications for leopard management and conservation in the Luangwa valley.			X	A report has been prepared and will be submitted shortly and presentations to ZAWA's Head of Research will be made as part of an annual ZCP Research Briefing.
Submit a paper to a peer-reviewed scientific journal, reporting this project's methodology, findings, and recommendations for management and future studies in the Luangwa Valley		X		As stated below, while a park survey would provide a stand-alone publication we feel the conservation impact factor would be greater if a park-GMA comparison can be made, which would only be possible next season due to expansions and design changes in the park study design.

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

No substantial difficulties arose during the study.

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

This study was the first intensive study of the leopard population in South Luangwa National Park. The survey lasted 87 days using remote camera traps covering over 200 km². The Zambian Carnivore Programme (ZCP), in collaboration with the Zambia Wildlife Authority (ZAWA) documented 18 leopards (two were excluded for mark-re-sight analysis as they were only photographed on one side) across the study area, with photographic captures ranging from one to four captures for each individual. Using this capture data in programme CAPTURE, a mark-re-sight software that uses the likelihood of recapture to estimate population size, ZCP estimated 23 leopards (SE 5.58 leopards) in the study area. Though leopard are difficult to age and sex based on camera trap photos alone, six males and five females were sexed, and a number of sub-adults and adults of both sexes were photographed. For density estimates, ZCP used standard density estimates developed from re-sights of individual leopards between different camera trap sites, mainly Mean Maximum Distance Moved (MMDM) and Half Mean Maximum Distance Moved (HMMDM), as suggested by previous studies. These distances were used to estimate the effective sampling area around each trap site, and the cumulative area was defined as the total effective sampling area. MMDM and HMMDM were determined the distances between these leopard recaptures (ranging from 2554 m – 7566 m; MMDM = 5196 m). Leopard density is 8.68 leopards/100km² (HMMDM) and 4.79 leopards/100km² (MMDM), estimates comparable with other high-density populations in Southern Africa.

Integral to the completion of this study was the involvement of members of the Research Staff of the Zambia Wildlife Authority (ZAWA). After the grant was awarded to ZCP, ZCP met with ZAWA to discuss how this study could best inform ZAWA's management decisions regarding the area's

leopard population. After discussing several objectives, ZAWA and ZCP determined that estimating leopard densities in the main tourist area of the park was the priority for this initial study. The study design was modified to survey a large study area in the park to generate reliable density estimate for the main area of safari tourism with the resources at hand. As proposed, ZAWA research staff was involved with the design, implementation, and analysis of leopard data. The local ZAWA ecologist and assistant ecologists accompanied ZCP staff to check camera traps weekly, trained to use state-of-the-art camera traps, and learned the basis of the study design. With the strong densities reported to ZAWA in a preliminary summary, ZCP advised ZAWA not to base any changes in leopard hunting quotas without further studies into the impact of increasing human encroachment, dynamic densities of competitive species such as lion and spotted hyena and other potential environmental and ecological variables that may affect the source leopard population for local trophy hunting. As discussed below, further leopard surveys in South Luangwa National Park and surrounding Game Management Areas (GMAs) are planned for 2013 to build from this study's design and results to address regional questions, particularly regarding increasing human encroachment. As part of ZCP's annual reporting to ZAWA, this study's design and results will contribute to future researchers and advise future monitoring and management of leopard populations.

This 87-day study generated 26,441 photographs of 16 species of herbivores and 11 species of large and small carnivores (in addition to leopard). This enormous dataset was integrated into ZCP educational initiative with Chipembele Wildlife Education Trust (CWET; www.chipembele.org) and a local secondary school, Mfuwe Day Secondary School. Over the last three years the school's conservation club, instructed by CWET, includes a field and computer lab component directed by ZCP staff. For the past two years, conservation club participants have actively learned about the scientific method, developed research questions that could be tested with camera traps, tested those questions in South Luangwa National Park using ZCP's camera traps, analysed photographs to address their research question, and presented their findings to their classmates. This year, ZCP staff members began a year-long study with the Mfuwe Secondary Conservation Club to address the role of seasonal and perennial rivers in species diversity. As most terms overlapped with this study and will overlap with planned camera-trapping studies, additional cameras were used by club members to collect their own data to address this question. The enormous dataset from this study was provided to the conservation club in order to expand the club's dataset for the student's analyses, providing more information for the students to practice their skills with general computer use and Microsoft Excel and Word and providing a larger sample size and thus more power behind their analysis.

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

As outlined in the previous question, this study provided several key opportunities for aspiring and professional wildlife biologists in the local community. In three months, five staff members from ZAWA research participated in the deployment and maintenance of camera traps in the field as well as familiarised themselves with the randomised design implemented in this project. Students from a local secondary school will use the photographic data of all wildlife species to answer their own questions about the correlation of species diversity and water availability. In addition to those stakeholders members of the safari guide community were informed of the study, how camera trapping could help inform their knowledge of the leopard population, and how the use of this non-invasive technology could assist in ZCP and ZAWA's monitoring of the leopard population. Finally, local ZCP staff members who are integral to ZCP's ongoing field research continued to develop their

skills using the equipment and survey methods used in this study. All of these stakeholders will continue to be involved with future camera-trapping plans and participate in planned large-scale surveys. This involvement is critical to the development of local wildlife research and management capacity; this study met all of its outlined objectives regarding this capacity building and future plans will continue to build on the involvement of students, safari guides, and ZAWA ecologists.

5. Are there any plans to continue this work?

ZCP plans to continue to address questions regarding the leopard population of South Luangwa National Park and surrounding GMAs. In particular, the completed study will be expanded to sample multiple areas of the park that represent presumably high and low leopard habitat to inform a park-wide population estimate. In order to better inform ZAWA management decision, ZCP and ZAWA discussed several questions regarding the environmental and anthropogenic factors that influence leopard density and distribution. As initially outlined in this proposal, conducting surveys of areas of differing management regimes is crucial to understand the effects of a number of variables on the distribution of leopards, their competitors, and their prey. ZCP is interested in using occupancy modelling to identify the limiting factors for these species on a sufficient enough scale, requiring a larger number of cameras and logistical support. The photo-database from this study will contribute to this effort, but sampling from areas with different habitats and human pressures must be sampled to address these research questions. ZCP and ZAWA will survey a portion of the Lupande Game Management Area, as well as other portions of South Luangwa National Park in 2013 to address these research questions.

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

For this study the primary communication will consist of two reports. One will be directed to the Research Department of ZAWA discussing the methodology, data analysis, and conclusions with technical detail. ZCP hopes that this in-depth report can provide ZAWA with an estimate of leopard in Zambia's most visited national park, inform ZAWA ecologists with information useful for camera surveys elsewhere in Zambia, and discuss potential efforts to better inform management decisions. The second report will be directed to the local safari guide community in South Luangwa National Park. This will also include the methodology, analysis, and results from the study, provide safari guides with more information about the leopard population that draws thousands of local and foreign visitors every year, and hopefully spark interest in involvement with the future efforts described in this report. With the adjustment of the study with ZAWA and the studies planned for next year, ZCP has decided to wait to publish this study in order to combine this dataset with more from South Luangwa National Park and surrounding GMAs.

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

As the grant was awarded several months after the proposed start date, ZCP and ZAWA needed to wait until the following year to implement the study. Specifically, funds were deposited in early October when the proposal outlined a start date of at the end of the previous May. As the rainy season reduces ZCP's field efforts for four months of the year beginning in late December, this study could not have been conducted any earlier than late in the following May, 2012. Though the field effort was only three months in length due to the change in study priorities, several months were needed for finalising the study design with ZAWA and preparing all of the necessary equipment prior

to the study's implementation. Though the proposed timeline involved nearly 6 months of camera trapping, the alteration in the study's timeline met the year-long expectation of RSG.

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
14 PC800 Hyperfire Camera Traps	4575	4693.21	-118.21	Difference in exchange rates from proposal submission to fund deposit.
14 Camera Security Enclosures	438	134.65	303.35	Smaller enclosures were purchased as the park-only survey didn't require the original heavy-duty enclosures.
14 Camera Locks	175	179.56	-4.56	Difference in exchange rates from proposal submission to fund deposit.
Shipping from Reconyx	262	48.03	213.97	Less charged as a bulk shipment
14 Sets of 12 AA Rechargeable batteries	462	435.14	26.85	84 Sets of 12 AA lithium batteries, recommended by camera trap company
14 2GB SD camera cards	54	76.30	-22.30	4GB cards were purchased instead of 2GB storage for more storage
Pelican 1630 Case for Camera Storage	0	200.72	-200.72	Purchased for camera transport in the field and storage in harsh conditions
Kingston Card Reader	0	12.88	-13.21	Purchased for photo download at camera site instead of exchanging SD cards.
Diesel for camera deployment	0	185.17	-185.17	11L per week for checking camera traps at 1.4 GBP/L
Total	5966	5965.67	0	Exchange rate at deposit of funds: 0.6416 GPD per USD Exchange rate at proposal: 0.6254 GPD per USD

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

With increasing human population and natural resource exploitation, regional conservation planning in developing countries is essential for conserving ecosystems and the species they contain. This study provided an estimate of leopard density for the most-visited park in the country, involved the training of ZAWA personnel, and contributed to an on-going education initiative. The next step is to extend the bounds of this type of study, to use camera trapping to identify the size of the population in the national park, estimate densities outside of the park that are under a different management scheme, and identify factors that affect leopards, their competition, and their prey in order to provide keystone elements of a plan to protect the leopards of South Luangwa. Additionally, maximizing the involvement of local wildlife professionals are key to any sustainable resource planning. This study expanded ZCP's capacity-building efforts and these larger scale studies will require even more involvement of community stakeholders.

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?

As part of ZCP's quarterly reports, a section was included updating the public on the status of this study, and identified RSGF as the funder for this first-ever effort in South Luangwa National Park. This accreditation and the RSGF logo (when allowed), also used in said report, will be included in any other public and ZAWA reports and future peer-reviewed publications that involve this study. Finally, RSGF is listed as a donor on ZCP's website.

11. Any other comments?

ZCP is very interested in collaborating with RSGF with the future efforts presented in this report as the relationship over the past year, from ZCP's perspective, has worked very well and this work has applications in ZCP's other project sites across Zambia.