

Final Evaluation Report

Your Details	
Full Name	Monica Mumbi Chege
Project Title	Using SNP Genotyping to Inform Conservation Management: A Case Study of Lions in Kenya
Application ID	32587-2
Grant Amount	£6,000
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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
Export of lion DNA samples to Leiden University for genotyping in November 2020.				The process took longer than initially expected due to the Covid-19 pandemic and administrative setbacks. Fortunately, I managed to acquire the required export permits and the DNA samples were received at the genetics lab in Leiden in May 2021.
SNP genotyping of the samples.				The lion DNA was genotyped at the SNP genotyping facility of the Institute of Biology, Leiden University, using the KASP technique (LGC Genomics) which uses allele specific primers to determine the genotype. The existing SNP panel was further extended three-fold by designing more primers and testing them on already available samples.
Bioinformatics analysis using Kraken (LGC Genomics) and downstream population genetics software (STRUCTURE, EEMS etc.).				Bioinformatics to assess the distribution of lion diversity and population structure in Kenya was largely completed (all exploratory analyses). From these analyses we realised that there were gaps in some of the populations, thus we intend to use some of the previous 'old' lion samples (collected in Kenya in 2002) that are available at the SNP genotyping facility in Leiden. The main purpose will be to ensure that the 'old' samples fill important gaps in the current dataset, specifically targeting populations for which there are questions regarding their management. Generation of these data would complete the sampling across the Kenyan lion population distribution; however, this is currently pending, awaiting acquisition of funds.

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

Export of samples: initially I had expected the process of acquiring permits and exporting the samples to take approximately 1-2 months, but the procedure took much longer than expected (~4 months) and also the costs of shipment were much more than what we had budgeted due to the required cold chain shipment to ensure that sample quality was not compromised during transport. We managed to acquire some funds from Leiden University and other sources to cover for the additional expenses.

When SNP genotyping was executed on the lion DNA samples, we noted that some important populations were missing from the sample set. Thus, we intend to fill this gap with other 'old' lion samples from Kenya that are at the SNP genotyping facility in Leiden. We then increased the SNP panel three-fold to ensure enough statistical power to infer population structure and diversity estimates. We also ran exploratory population genetics analyses, and now have a working pipeline which can be easily re-run after including more data from more samples.

This project is part of a larger PhD project that will also cover lion diet analysis and lion movement in relation to lion-livestock conflict in Kenya i.e., with Objective 1. being "Using SNP genotyping to inform conservation management: a case study of lions in Kenya", Objective 2. An analysis of independent factors influencing lion ecology in LNNP and adjacent Soysambu Conservancy and subsequent Human - Lion conflicts in Soysambu in comparison to Amboseli National Park and Objective 3. Lion diet and predator-prey relations in LNNP and adjacent Soysambu Conservancy [as was stated in the initial proposal to Rufford foundation].

As part of Objective 2., three lions were re-collared with a satellite collar from Africa Wildlife Tracking (AWT) at Lake Nakuru National Park (a male and female) and Soysambu Conservancy (a female) in 2020. Unfortunately, one collar in Lake Nakuru National Park and the one in Soysambu malfunctioned early this year and the process of fund raising for replacement to buy new collars has been successful. Consequently, the two lions will be re-collared in February 2022.

Further, to ensure proper time management as the process of export of the lion DNA samples was on-going, with the support of my supervisors, I was able to undertake 2021 fieldwork as scheduled for Objective 3, through funds acquired from the National Geographic Foundation.

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

The SNP genotyping was successful and exploratory analysis confirm strong population structure in Kenya, which is relevant for management, especially translocations. We are confident that we can generate results that will directly inform policy through inclusion of genetic information in management of lions in the country i.e.:

- 1.) Determine suitable target populations to which conflict individuals can be translocated (based on genetic signatures).
- 2.) Assess inbreeding risks that may be brought about by low genetic diversity in small and isolated populations.
- 3.) Inform decision making regarding translocations to mimic gene flow, if this will be considered necessary, in certain situations and the results may feed into a new genetic management plan and strategy for lions in Kenya.

By generating the necessary data for efficient conservation of the species, the research will be able to contribute to the improving community livelihoods through benefits from tourism. Further our study can provide a platform for conservation of other co-occurring species as the genetic population structure is often similar.

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

Various components of the research project have ensured community involvement/benefit.

As part of ensuring that community livelihoods are not compromised, the Government of Kenya, through the Kenya Wildlife Service, has to ensure that 'problem lions' that repeatedly attack livestock and/or humans are well managed as lethal control of 'problem individuals' is largely avoided. Through Objective 2., lion diet analyses can help in identifying the prey that lions rely on, by using non-invasively collected scat samples. This can illustrate not only how strongly lions depend on livestock, but also if there is a preference for livestock. Individuals who rely on livestock more strongly may be suggested for translocation, in order to alleviate damage to local communities. Thus, objective one will inform translocation sites while objective two will advise on extent of 'dependency' on livestock.

The lion collars fitted on lions in Lake Nakuru NP and Soysambu Conservancy have worked to ensure the building of synergy with the community in Soysambu through provision of an early warning system. By sharing satellite collar data of lions approaching livestock bomas with the conservancy management and setting up of boma alarms in the conservancy, livestock depredation incidences were prevented. The management of Soysambu was able to brief the community/livestock herders every morning on the location of collared individual lions through their ranger base radio network and in turn these areas were avoided.

5. Are there any plans to continue this work?

Yes. As soon as funds are acquired to finalise the SNP genotyping of the 'old' samples at the SNP genotyping facility in Leiden to fill important gaps in the distribution and the bioinformatics part, the manuscript will be finalised and submitted to a peer review journal.

Plans are also there to finalise the fieldwork during 2022 and collar two lions in Lake Nakuru National Park in February 2022.

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

In peer reviewed journals, national and international conferences, workshops, reports as well as meetings. There will be a particular focus on engaging with policy makers, bridging the well known gap between geneticists and practitioners, to ensure that the genetic data are used in the decision-making process.

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

Activities	Jan 2021	Feb to May 2021	May 2021	June – Sept 2021	Nov - Jun 2022
Export of DNA samples					
SNP genotyping of the samples.					
Completion of exploratory analysis, Bioinformatics analysis using Kraken (LGC Genomics) and downstream population genetics software (STRUCTURE, EEMS etc.).					
Write up of Chapter - Topic: SNP genotyping to inform conservation management: a case study of lions in Kenya "					

KEY

Planned	
Completed	
On-going /Actual	

8. 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
Administrative costs for NGO receiving grant	20		-20	Not charged
Whole Genome Amplification	980	1000	+20	
SNP Genotyping (160 samples)	5000	5000		
TOTAL	6000	6000		

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

Although the current SNP dataset covers most of the lion populations in Kenya, there are still some sampling gaps. To fill these gaps, specifically for populations with outstanding management questions, we intend to use the 'old' sample set that is at the SNP facility in Leiden. To create a complete overview of the distribution of genetic diversity of lions in Kenya, it is important that we use these 'old' dataset to fill in these sampling gaps. The expansion of the existing SNP panel provides us with enough power to detect local population structure (as was shown in exploratory analyses of the existing data).

Bioinformatics to finish analysis and interpretation of results and publication of a scientific paper that will inform management.

Finalise the fieldwork season for 2022 and write the two chapters for objectives 2 and 3.

10. 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, in two international conferences.

- 1.) I mentioned support by The Rufford Foundation during the Annual Carnivore Conference at the Kenya Wildlife Service that hosts over 150 participants from Kenya and other countries.
- 2.) I used the Rufford logo and mentioned support during presentation at the Netherlands Annual Ecology Meeting which hosts more than 700 people working in the field of ecology and/or evolution.

In addition, progress reports to the Kenya Wildlife Service had a Rufford Foundation logo.

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

Dr. Moses Otiende – based at the KWS lab guided me in laboratory work and acquisition of samples.

Dr. Laura Bertola – is my co-supervisor and will guide in the DNA genotyping, analysis of results as well as guide in the write up of the chapter.

Prof. Hans de Longh – He is my academic supervisor, and co promotor, he has guided me throughout the process and will also be helping me as I integrate lion ecology and genetic results to inform management.

Prof Geert de Snoo- he is my promoter who supervised me during the process and carries final responsibility at Leiden University

12. Any other comments?

My activities were quite successful despite the setbacks due to the Covid-19 pandemic and administrative setbacks in the shipment of the DNA samples, I am now approaching the final steps of my research and would like to request Rufford Foundation to consider me for the third grant nomination to finalise our assessment of the distribution of genetic diversity of lions in Kenya, as well as the bioinformatics sections and data collection for the other final section of the PhD.