Final Evaluation Report

Your Details	
Full Name	Monica Mumbi Chege
Project Title	To fence or not: Factors influencing lion population dynamics and conflict, a case study of two national parks in Kenya.
Application ID	27349-1
Grant Amount	£5,000
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Date of this Report	04 June 2020

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
SNP genotyping to inform conservation management: a case study of lions in Kenya (**NB:** as indicated in my progress report this objective was expanded to cover the entire country in order to better inform lion management.)				The aim of this objective is to demonstrate use of lion (*Panthera leo*) genomic information to directly support lion conservation management strategies. By acquiring lion DNA data, we would like to show existing patterns of diversity i.e. lion population structures, connectivity between populations and within-population genetic diversity to inform their management. To achieve this objective, 171 lion tissue and blood samples were collected across the country and from the bio-bank of Kenya Wildlife Service (KWS) forensic and genetics laboratory. DNA extraction was successfully carried out for all samples. Further analysis i.e. genetic profiling is pending due to lack of funds.
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				During the fieldwork period, two lion prides were identified in Lake Nakuru National Park, consisting of six individuals; one pride was identified in Soysambu conservancy, consisting of nine individuals. Savannah Tracking Ltd (collar manufacturing company based in Kenya) donated three GPS collars and boma alarms for the study. Subsequently, two collars were fitted on two individuals in Soysambu conservancy (SC) to assist in averting conflict and one collar was fitted on a male lion in Lake Nakuru national Park. In SC, the collars aided in averting livestock depredation, through an early warning system and deterrence. The collars are fitted with a software that triggers an alarm (installed inside a livestock *boma)*, when a collared lion is

				within 150 to 200m radius from the livestock boma. Thus, deterring the lion from approaching/alerts the livestock keepers. Through an MoU with Soysambu management, I shared the collar data so as to build synergy. Through this collaboration we set up boma alarms in different locations within the conservancy. Using the collar information, we were also able to know the location of lions and thus livestock keepers were informed to keep off these locations to avoid predation. More funding was acquired and for purchase of three collars. Three more lions were collared, two in Lake Nakuru National Park and one in the adjacent SC. A total of 30 questionnaires were administered in SC. In Amboseli National Park a total of 30 adult lions and 15 cubs were identified.
Lion diet and predator-prey relations in LNNP and adjacent Soysambu Conservancy				10 prey transects were set up in Lake Nakuru National Park and Soysambu conservancy (seven in LNNP and three in SC). 116 lion scats were collected - 60 in LNNP and 56 in SC. A total of seven prey transects were set in Amboseli National Park and 66 scats were collected in Amboseli National Park. The lion scats will be used to aid in identifying prey species consumed and thus determine lion prey preference. I have two more fieldwork periods planned (wet and dry season) to collect scat.

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

There were several difficulties during the fieldwork period, and I tried to be as adaptive and flexible as possible so as ensure that the objectives will be achieved.

With the expansion of my objective to provide a nationwide outlook of the genetic makeup of lions in Kenya, this required collection of samples from various populations that were representative of the Kenya lion population. Since it would have been quite expensive to physically go to various parts of the country, I liaised

with all the Kenya Wildlife Service Field Veterinary Officers based in various parts of Kenya to collect opportunistic samples and paid for courier costs for transporting the samples to Nairobi. There were challenges also with lack of equipment for collecting and preserving the samples. The Kenya Wildlife Service veterinary department assisted with ethanol for preserving samples and cool boxes were provided for transporting the samples from the field to the forensic lab (all samples were stored in the forensic lab) in Nairobi.

The lion population in Lake Nakuru National Park and Soysambu conservancy is rather low and sighting lions was difficult, this coupled with the challenge that the lions in Soysambu conservancy are very shy, led to an addition of more fieldwork days than initially anticipated i.e. a total of 25 days, spread out over 3 months. We also worked for longer hours in the field, including during the night. I also liaised with the Kenya Wildlife Service Field Veterinary Officer based at Nakuru to collect blood and tissue samples during routine lion intervention cases that involved immobilisation.

The delivery of the DNA extraction kit through the local supplier in Kenya took 8 weeks longer than expected as the supplier had to import it. Once the kits and other reagents were delivered, the KWS forensic lab was closed due to the COVID 19 outbreak and I had to wait for an additional 7 weeks for DNA extraction.

Collection of samples was quite successful as 171 blood and tissue samples were collected. The funds available were limited and thus to ensure they were well managed, I was advised by head of forensic lab at KWS to extract all the collected samples before commencement of sequencing, thus Qiagen extraction kits for 250 samples were bought instead of the initial one for 100 samples. This was also done to avoid any future confusion of working with the samples in the lab, it was more prudent to extract all the samples.

Additional funds were raised to cover for the additional fieldwork days and courier of samples.

Two of the lion collars in Lake Nakuru National Park malfunctioned after 3 months, we managed to replace them earlier this year.

In SC, a collared male lion (whose collar had malfunctioned) ventured approximately 60 km away from the conservancy and was unfortunately killed by the community after predating on livestock. Another male also ventured out of the conservancy to the same area and through the KWS community wildlife service department, the communities were appeased not to retaliate the lion was relocated to Lake Nakuru national park. I provided a collar to monitor his movement and prevent future conflict incidences.

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

1. Collection of tissue samples and extraction of DNA which was more that 90% successful, after running the extractions on agarose gel, it showed that the

extractions mostly contain of a lot of DNA, so we are confident that genotyping will be successful.

2. Preliminary results of hair microscopic analysis of lion scats indicate that the main prey species in Lake Nakuru National Park is the buffalo (*Syncerus caffer*) and common warthog (*Phacochoerus africanus*) that made 37% and 25% of the lion diet, in Amboseli National Park the common zebra (*Equus quagga*) and blue wildebeest (*Connochaetes taurinus*) were 44% and 38% respectively.

3. Through use of the installed lion collar so far, we have gathered the following information:
    a. Avert conflict: the boma alarms were able to discourage lions from attacking livestock inside bomas on three occasions, collar data was used in numerous occasions to warn cattle herders of lion presence thus deter conflict.
    b. Home range of lions both in LNNP and Soysambu, two of the lions collared in Lake Nakuru (male and female) never left the park and spent most of their time in the south west and northwest sections of the park, another collared male spent a lot of time along the Lake Nakuru-Soysambu conservancy fence line and did not leave the park. The three collared lions in Soysambu also never ventured into the park, one male moved more approximately 60 km from the conservancy and was unfortunately killed due to conflict.

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

The two collars fitted on lions in Soysambu have worked to ensure building of synergy with the community in Soysambu through provision of an early warning system. By sharing collar data with the conservancy management and setting up of boma alarms in the conservancy, livestock depredation incidences were avoided. The management of Soysambu was able to brief the community/livestock herders every morning on the location of collared individuals 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 the extracted DNA will be shipped to Leiden University for genetic sequencing and analysis of results.

Initial plans were to continue field work from July to October 2020, however, due to the COVID 19 pandemic the field work has been pushed to February 2021.

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

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

The grant was used in phases over a period of 1 year. i.e. a.) collection of samples, b.) acquisition of lab reagents c.) DNA extraction d.) Purchase of a laptop. This was due to the various variables in the field such as availability of a KWS veterinary doctor for the biopsy darting, availability of samples and equipment.

* Collection of samples from field veterinary vets has been a continuous process.

Activities	June 19	Month 1 (July 19)	Month 2 (August 19)	Month 3-8 (September 19 -January 20)	Apr-20	April - December 20
Biopsy Darting						
*Collection and gathering of lion blood and tissue samples						
DNA extraction and Analysis						
Write up of Chapter - Topic: SNP genotyping to inform conservation management: a case study of lions in Kenya "						

KEY

Planned	
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
Accommodation and Food (@ £ 20 per day	£1400	£1000	-£400	Less amount was used as a private sponsor supported

for 7 days for 10 weeks				part of the fieldwork
Vehicle fuel (@ £ 22 per day for 5 days for 10 weeks)	£1100	£863	-£237	
Vehicle hire (@ £40 per day for 5 days for10 weeks)	£2000			
1 Camera + 70-300MM lens	£500		-£500	Not bought because my laptop crushed and requested for a replacement.
Rufford Grant TOTAL	**£5000**	**£1863**	**-£3137**	
DNeasy Blood and tissue DNA extraction kit - 250 reactions		£1,033	£730	Collection of samples was quite successful as 171 blood and tissue samples were collected. To ensure uniformity and order in handling of samples, I was advised by the head of the forensic lab at KWS to extract all the samples before commencement of sequencing thus a Qiagen extraction kit for 250 samples was bought instead of the initial one for 100 samples.
PCR reagents (master mix)				
Agarose gel electrophoresis reagents				
Onetaq 2X quickload mastermix 500 reactions		£553		
Analytical grade Ethanol 2.5 litt		£20		
TAE buffer		£55		
Laboratory costs		£599		
Biopsy darts /darting accessories		£378		
Laptop		£766		£500 from Rufford foundation was used, the extra amount (i.e. £299) was acquired from private sponsor
Overall Project Total		**£3404**		Exchange rate: 1£ = Kes126.56

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

To achieve the first objective, it is important that the extracted samples are sequenced so that the following information can be obtained:

a) The number of genotypes present in the country.
b) Genetic diversity of lions (e.g. allelic richness, heterozygosity).
c) Inbreeding indices estimates.

Publishing of the results to inform management.

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, during the annual carnivore conference that hosts over 150 participants from Kenya and other countries.

Progress reports to KWS had 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 the DNA extraction process and lab work and acquisition of samples.

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

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

12. Any other comments?

My activities were successful at I am at a crucial point in my data gathering and analysis, and therefore, request The Rufford Foundation to consider me for the second grant nomination to finalise genetic sequencing.